The Electrical World.

VOL. XXVI. NEW YORK, SEPTEMBER 21, 1895. No. 12.

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY,

253 Broadway, New York.

Established 1874. Incorporated 1889.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York

New England Office, 620 Atlantic Ave., Boston.

Western Office, 936 Monadnock Block, Chicago.

Philadelphia Office, 927 Chestnut Street.

SUBSCRIPTION IN ADVANCE, ONE YEAR, $3.00,

in the United States, Canada or Mexico; other foreign countries, $6.

In requesting your address changed give OLD as well as new address.

Now in its third decade, THE ELECTRICAL WORLD is the Pioneer Electrical Journal of America, and has well maintained its lead. It has the largest Circulation of any electrical periodical, and is the best Advertising Medium.

THE ELECTRICAL WORLD'S Advertising Rates are much lower than those of any other similar publication, circulation considered, and vary according to space, position and number of insertions. Quotations promptly furnished.

Address and make drafts, orders, etc., payable to

THE ELECTRICAL WORLD,

253 Broadway, New York.

VOL. XXVI. NEW YORK, SEPTEMBER 21, 1895. No. 12.

CONTENTS.

Editorial 305
The New York State Street Railway Association 307
Old-Time Telegraphers 307
Anti-Trust Litigation Against the Bell Company 307
A Rumored Philadelphia Electric Light Deal 307
Magnetic Units 308
Electrical Ottawa 309
The Canadian Electrical Association 313
Electricity and Gold Dredging, by Ralph L. Montagu 314
Springfield Meeting of the Society for the Promotion of Engineering Education 315
The Invention of the Electromagnetic Telegraph—V., by A. M. Tanner 317
Electrodynamic Machinery—XLVIII., by Edwin J. Houston and A. E. Kennelly 321
The Standard Telephone Company 322
Digest of Current Technical Electrical Literature, compiled by Carl Hering 323
New Books 325
Accumulator Traction, by Maurice Barnett 326
Automatic Limit Switches 327
DEPARTMENTS:
Financial Intelligence 328
Special Correspondence 328
General News of the Week 330
Trade and Industrial Notes 331
Illustrated Record of Electrical Patents 331

ELECTRICITY IN GOLD AND SILVER MINING.

The article on the application of electricity to gold dredging, printed elsewhere in this issue, illustrates another of the numerous applications of electricity, and one so obvious that it will probably be generally extended throughout placer mining districts. In this case, on account of the high price of fuel, the wealth known to exist could scarcely have been realized by any other means, and in no event with anywhere near the same convenience. The gold and silver mining regions furnish ideal conditions for the use of electrical power, and we may expect vast extensions of such use as the success of pioneer installations becomes plainly evident, particularly of those employing polyphased systems. In probably very few mining districts is there any lack of water power within a reasonable distance, and where the system of mining requires any considerable quantity of power, electricity is the obvious source and by far the most convenient agent, from its ease of application to all manner of work. Owing to the conditions in many places, the pole line is a weak point where the power has to be transmitted a considerable distance, but this can be overcome by cheaply installed systems of underground transmission, which, however, do not always seem to have been considered. In Europe it has been found that cables simply buried in a trench over a porous bed (sand always being used there as the bed) give better results than the most elaborate conduit system, and the same method could, of course, be applied in many cases in mining regions where a long pole line would introduce an element of unreliability during certain seasons. Owing to the great amount of thought now being devoted to the subject of electro-metallurgy, it may be that methods will be devised whereby precious metals will in most cases be directly extracted by electricity from ores as they come from the mines, or at least the valuable minerals so concentrated as to greatly reduce carriage costs. At present the electrical method of refining from concentrated products reduced by heat is in large use, a huge establishment for the separation of precious metals in this manner having just been put in operation at Perth Amboy, and if the first step could also be accomplished by electrical means enormous savings in shipment charges would be effected. With the great water powers existing in the mining regions of the far West and the absence of cheap fuel, the field for the employment of electrical energy there is one which should result in vast developments.

A CANADIAN ELECTRICAL CITY.

The meeting of the Canadian Electrical Association at Ottawa during the present week promises to be one of the most successful in the history of that body, both from the professional and social standpoints. In another column we print a historical sketch of the Association, which, though of but comparatively recent foundation, has already reached a stage worthy of the interests it represents. As a meeting place Ottawa is peculiarly appropriate, being probably the most advanced city on the American continent with respect to the employment of the electric light and the number of miles of electric railway in use. With a population of 50,000 there are 50,000 incandescent lamps in use and 29 miles of electric road are operated. In the account of the electric light and street railway interests of Ottawa, printed elsewhere in this issue, will be found many points of general interest to the engineer, for in few instances have the various problems presented been as carefully and successfully worked out. The method used for preventing wide variation of street railway voltage is an example to point, and one which will commend itself where water power is employed. The statistics in regard

to the enormous increase of street railway traffic following the adoption of electric traction are most significant; from $26,000 per annum with horse cars, the net receipts after four years of electric traction grew to over $193,000, and as the increase indicates benefits conferred, these figures give an idea of the value to a community of the "deadly trolley." The city also derives a benefit of a special kind from an arrangement with the railway company, whereby the streets in which its tracks are laid are kept cleared of snow during the winter, five electric snow-sweepers and three "walkaway" plows being used for this purpose. A hint might be taken from this by street railway companies elsewhere, and a source of revenue thus added during the winter season. It seems probable that city authorities would be willing enough to enter into a contract with electric railways for the clearance of snow from the streets, particularly as the facilities of the latter should enable them to do the work with profit for a less sum than possible otherwise, the final hauling being done at night. Altogether Ottawa offers an ideal place for the meeting of an electrical body, and its advantages might be availed of with profit in the future by electrical associations from this side of the line.

A NEW FAD.

Time was when the theorist had little thought for the practician (if we may use a word now greatly in vogue with our English contemporaries), but a change in this respect seems to be coming over the spirit of the former, if we are to judge by the solicitude so frequently expressed nowadays when the supposed interests of the said practician are concerned. Formerly the non-practician pursued his ends in his own way, entirely regardless of how they might be viewed by other than his own class, and notwithstanding their bearing on the domain of practice. If the professor wished to introduce a new word into engineering literature, for instance, he did so without asking the permission of the engineer, and without a thought as to how he would regard it. The practical man's lack of sympathy with mathematical methods was regarded as an evidence of inferior intelligence, and his suspicion of new phraseology but a sign of ignorant conservatism. Now, however, a different attitude is often noticeable, and a subservience, in words, at least, expressed toward those on whom formerly no thought was bestowed. Theory is apologized for, mathematics is administered with deprecation, and scientific nomenclature excused as a necessary evil, while the supposed prejudices of the practical man are deferred to, and his opinions treated as oracular. If this new attitude were in all cases sincere it might be ascribed as the result of a recognition of the superior claims of practice on the part of those devoted to theory, but this, however, is probably not always the case. The cause seems rather to be in the adoption of the methods of the politician, the practical man becoming the subject of flattery, sometimes for ulterior purposes. Now that the theorist looks for an important augmentation of income from the sale of books written for the practical man, from expert testimony before courts, and as a member of advisory bodies, it is to his interest to court the public and even assume to be in sympathy with the popular cry against theory. Hence the solicitude oftentimes expressed that the practical man be not deluged with theory, or wearied with mathematics or bothered with new scientific names, or, in fact, disturbed in any of his supposed prejudices. The leopard, however, does not change his spots, and the deference thus implied is little likely to be sincere, while, on the other hand, the object of it is not apt to be long deceived, if at all.

ELECTRICITY AND QUARRELS.

At a ratepayers' meeting held in England several months ago to consider an electric lighting measure, one of the speakers is reported to have said that "The electric light question has torn asunder friendships that have lasted for years, and men now pass each other in the streets like dogs." While we on this side of the water are inclined to be less intense than our British cousins in our feelings with relation to local public affairs, yet when an electrical element enters, the quarrelsome spirit oftentimes asserts itself. As an example to point, we quote the following from a Western exchange: "The City Council had a genuine monkey and parrot time of it Saturday night over the electric light bill, which has caused so many sleepless nights for the members of that honorable body. For over two hours the battle raged, and great chunks of oratory, rhetoric, vehemence, spite, filibustering, parliamentary practice and other convenient war implements were hurled at heads in a manner that was astonishing. Some members grew nervous while speaking, and showed clearly that they felt even more than they dared to utter. Mr. Everett's grammar got entangled in Mr. Whitlock's whiskers, and Councilman Gottfried's eloquence was hurled in an impetuous manner at the ears of his associates, while the complacent smile of Mr. Porter profusely decorated his face, and the stammering of Mr. Mack was up to its usual standard." One of the members threatened that if the Village Council enacted the "villainous" bill under discussion he would carry the matter to the United States Supreme Court, but to his credit, be it added, accepted the inevitable when the bill passed, and made a motion that the plant be put in operation within 90 days. Another Western exchange pays its editorial compliments to a contemporary opposed to it on an electric lighting question in the following words: "The ancient and dishonorable gas paunch, true to its owners, true to its low instincts, venal first, last and all the time, emits from its corrupt and corrupting personality almost a column of editorial in defense," etc., and later on characterizes the rival sheet as "dishonest and misleading in every shred of its vile screed, seeking to make capital with the people in the interest of its masters at the expense of the truth." Why electricity should have an effect similar to theology and politics in exciting rancor, is a question that might well receive the attention of psychologists.

The Electrical Production of Carbon.

It has been recently shown, says the London *Electrician*, that at the highest temperature attainable in an electric furnace, all substances other than carbon are dissipated and removed, with the result that the ends of the electrodes are not only graphitic but are also sensibly pure. It follows that a carbon plate or rod, of dense graphitic structure, good conductivity and unusual freedom from impurity, should be producible by exposing the ordinary moulded article to the temperature of the electric furnace. This is precisely the direction in which Messrs. Street and Girard have been working. They claim to have succeeded in producing a form of carbon the conductivity of which is fourfold that of the untreated material, while its resistance to chemical action is also much enhanced. Taking the density of an ordinary carbon before heating as 1.98, they find that after treatment it has attained a density of 2.6. Should this figure be corroborated, it must be considered remarkable, inasmuch as the density of graphite obtained by ordinary means is not higher than 2.3, while the same figure has been observed as a maximum for hard gas carbon. Analysis of the carbons thus made indicated that the percentage of carbon transformed into graphite was about 80 to 85 per cent. The method of analysis is, however, by no means beyond criticism, depending, as it does, on the conversion of the graphite into the highly indefinite body known on the *lucus a non lucendo* principle as graphitic acid, which in no way resembles graphite, or comports itself as an acid. This point, however, may safely be left for future settlement. The precise percentage of graphite is not of moment provided a product has been obtained possessing many of the properties that would be exhibited by a sound coherent block of that form of carbon. When once criticism is allayed by the appearance, in a marketable form, of carbon which is nearly free from other elements than C and neither oxidizes easily nor irregularly, nor breaks up when used as an anode for aqueous or igneous electrolysis, an ample field of application will at once be open. To take one of the most pressing cases alone: it is notorious that next to the want of a good diaphragm the most urgent need of those interested in commercial electrolysis has been a reliable, unattackable anode.

The New York State Street Railway Association.

Arrangements are now all perfected for the forthcoming convention of the Street Railway Association of the State of New York, to be held at Albany, Sept. 17, 1895. Indications point to a large attendance and an interesting and instructive meeting. The headquarters of the Association and the banquet in the evening will be at the Kenmore Hotel. The place of holding the convention will be the lecture room of the Y. M. C. A. building, which adjoins the hotel, thus making attendance very convenient. A ride about the city of Albany and visit to Troy upon the cars of the Albany Railway Company and return home by boat, will be among the special features of entertainment provided by the local committee.

At the annual dinner the toastmaster will be Mr. J. H. Stedmans of Rochester, who is always happy and felicitous upon occasions of this character. The list of toasts has not been allotted as yet, but will comprise some 10 or 12 responses by prominent street railway representatives.

Among those who will read short papers upon practical subjects before the convention are W. W. Cole, of Elmira; Messrs. Newton & Allen, of Syracuse; Benj. F. Norton, of Newburgh; Mr. McElroy, of the Consolidated Car Heating Company, Albany, and several others whose names will be announced later.

Old-Time Telegraphers.

The fifteenth annual convention of the Society of the United States Military Telegraph Corps and the Old-Time Telegraphers and Historical Association opened on Wednesday, Sept. 11, at the Broadway Central Hotel, with President Edward C. Cockey in the chair. Mayor Strong, in behalf of the city, made an address of welcome, and the meeting then proceeded to routine business. The election of officers resulted as follows: S. A. Duncan, Pittsburg, Pa., president; J. D. Flynn, of Pittsburg, Pa., vice-president, and W. J. Dealy, of New York, secretary and treasurer. Pittsburg was selected as the place for the next convention.

On Thursday the members went down to Long Branch on a steamer chartered for the occasion, and on Friday they divided up, one section visiting the city institutions on Blackwell's and Ward's Islands on the invitation of Commissioner Porter, and the other going to West Point on a special train tendered by the West Shore road.

Among the delegates were R. J. Hutchinson, superintendent of the Stock Exchange Telegraph System; J. H. Emerick, of the Postal; E. Rosewater, of Omaha, Neb.; W. R. Plum, of Chicago, Ill.; Dr. J. E. O'Brien, of Scranton, Pa.; J. B. Taltavall, J. E. Pettit, of this city; W. B. Wilson, of Holmesbury, Pa.; William J. Dealy, George H. Usher, of the Postal; A. G. Hummel, of the Stock Quotation Company; M. W. Royers, C. R. Richardson, A. A. Wilson, Charles P. Bruck, John F. Shorey, Charles Seaton, of Baltimore, Md.; Miss Marion H. Kerner and Mrs. Edward C. Cockey.

Anti-Trust Litigation Against the Bell Company.

The United States District Attorney, at Chicago, has been asked to bring suit in behalf of the people against the American Bell Telephone Company for violation of federal anti-trust laws. A request will, it is reported, also be made to Attorney General Moloney, of Illinois, to prosecute the same corporation for violation of similar State laws. James E. Keelyn, president of the Western Telephone Construction Company, and also president of the National Telephone Protective Association, has submitted evidence to United States District Attorney Black bearing on the case. Since Mr. Keelyn's first move in the case other evidence has accumulated, which, it is claimed, proves so clear a violation of anti-trust laws that the respective federal and State officers are certain to act thereupon. In its famous agreement with the Western Union Company, the Bell Company agreed to pay the latter 20 per cent. of all royalties on its telephone rentals, and the Western Union Company agreed to abandon its existing exchanges and abstain from all telephone business. The contract expires nominally in November, 1896, but contains a provision for renewal. In 16 years the Western Union Company is said to have collected about $5,000,000 of the Bell Company's royalties.

Chicago is thought by those at the head of the present movement to be the best place to bring a quo warranto suit against the corporation, because it is in this city that the Bell Company manufactures its telephones through the Western Electric Company, which furnishes a tangible commercial point of attack.

A Rumored Philadelphia Electric Light Deal.

During last week a rumor was current in Philadelphia to the effect that a movement is on foot to form a company, having for its object the absorption of six of the principal local electric lighting plants of that city—the Edison, Powelton, Columbia, Suburban, Manufacturers' and Diamond. According to the plan proposed, the new company was to be organized with a capital stock of $5,000,000, to be divided equally into common and preferred stock, the latter to be subscribed for with the common stock as bonus. Part of the plan is stated to be to allot the Edison Company two millions in bonds for two millions capital stock, with 17 per cent. in cash in addition.

The total capitalization of the companies named is as follows: Edison, $2,000,000; Suburban, $300,000; Diamond, $250,000; Manufacturers' (paid in), $203,500; Powelton, $450,000; Columbia (paid in), $66,000.

The general manager of the Manufacturers' stated that he had no knowledge of any such combination, but he thought, however, it would be a good step to take.

The *Ledger* reports that a gentleman who has kept the run of local electrical interests pretty closely, and has some of his money in them, remarked that the projected pool bore to him the appearance of a speculation pure and simple, with more or less of a trade with political and official influence as its chief basis. "On one side," he said, "there is a company with no plant or much of anything else, and, on the other, substantial interests that are practically occupying a more or less profitable field. Why these should be consolidated is something I cannot see. The company that has nothing should, of course, favor it, but why should the other? It has the appearance simply of one concern that has nothing endeavoring to make a profitable deal at the expense of interests which represent something."

The Standard Telephone Company in Philadelphia.

The Philadelphia *Ledger* reports that the Standard Telephone Company has acquired control of the Mutual Automatic Telephone Company of that city. Gen. Clarkson has been made president of the local company, and it is said that Mr. R. M. McWade has been selected for general manager. The Automatic Telephone Company is the owner of a valuable franchise, granted to Mr. Charles P. Persch, a local politician. Commenting upon the transfer of the franchise, the *Ledger* states that the Council can in a few weeks pass an ordinance offering the telephone franchise to the highest bidder, and that the Standard Company and the Drawbaugh Company, and perhaps some others, could as well afford to make bids for the privileges as to buy out Mr. Persch. It is not probable, however, it is added, that the Council will act in such a disinterested way as to permit the city treasury to be the sole beneficiary in the grant of franchises.

Electrolytic "Parting" of Gold and Silver.

The German Gold and Silver Separation Works at Frankfort are using an electrolytic method of "parting." According to ordinary modern practice, the separation or "parting" of gold and silver is effected by boiling the granulated alloy with strong sulphuric acid, in which silver is soluble, while gold is unattacked. This method has almost entirely displaced the time-honored process of parting with nitric acid, its smaller cost being a tangible advantage, even when dealing with raw materials as valuable as the precious metals. It has now a competitor, actually working on a commercial scale, in the electrolytic process about to be described. The auriferous silver to be parted is cast into plates, which are enclosed in linen bags and made the anodes in a weak solution of silver nitrate made acid with nitric acid. The cathodes, which are thin plates of fine silver, are suspended, without covering, in the bath, and below them is a tray, the bottom of which is of linen. Seeing that there is no difficulty in melting finely-divided silver into an ingot without loss, there is no need to endeavor to precipitate the metal upon the cathodes in a coherent form; thus it happens that a high current-density can be used and the silver deposited pell-mell; scrapers being employed to sweep it down from the cathodes into the tray at the bottom of the bath, and prevent the occurrence of a short circuit. The linen bags containing the anodes are emptied of their residual gold once or twice a week, according to the richness of the alloy treated. Copper which may be present in the original alloy, remains in solution as nitrate, provided a little fresh nitric acid be added to the electrolyte from time to time.—*London Electrician.*

Magnetic Units.

The correspondence invited by the London *Electrician* on the subject of magnetic units is continued in the columns of that journal for Aug. 30, Messrs. Ewing, Esson, Ravenshaw and Andersen contributing their views.

Mr. F. V. Andersen is opposed to the definition of magnetic units in terms of the centimetre, and believes that if a decimal foot of ten inches and the avoirdupois pound were agreed upon they would have "the immense advantages accruing from the use of a rational system," it being added that "the C. G. S. system, besides having unsuitable fundamental units, is not a rational system." Mr. Andersen explains a system of magnetic units used by him, which consists of a unit of magnetic intensity of the value of 1,000 lines per square inch, and a unit of magnetizing force of one ampere-turn per inch. Mr. Andersen believes that the factor of $\frac{1}{4}\pi$ is no more convenient than 313.3, which his system introduces.

Mr. H. W. Ravenshaw says that "the sarcasm of a third-year student, who wasted hours in drawing the most beautiful German capitals, at last induced me to multiply my square inches by 6.45 and my minutes by 60. It looks better, but it is more trouble." As to the units, he believes they should have the same relation to each other as the volt, ampere and ohm, which will remove a great difficulty from the path of many students who have to teach themselves, and who always seem to find it so hard to get beyond Ohm's law. He does not see that any other units are wanted. With regard to the 4π question, he does not think that it is generally known that $2\,\mathfrak{H} =$ the ampere-turns per inch long within 2 per cent. This he considers as immensely useful, as all lengths can be taken in inches, so that he would be very sorry to see 4π disappear.

Mr. Esson does not consider it necessary to seek names for intensity of magnetic flux, total magnetic flux or magnetizing force. He says that "practicians" who write on questions of construction are likely to adopt the language they have found most useful, whatever new names may be invented by the physicists, which names will not benefit the "practician" nor make the slightest difference to him.

Prof. Ewing's letter is as follows:

"It is after hesitation, and with some reluctance, that I comply with your request to take part in the discussion of this question. The fact is I have not been able to see that the proposed new names and new units are needed. When so clever a man as Prof. Lodge takes all these pains, I should like to believe that his proposals are meeting a felt want. But by whom is the want felt? I hold strongly that in this matter necessity should be the mother of invention. Dr. Lodge offers us sundry bantlings for adoption, but where is the maternal parent? New names and new units will be worse than useless unless they quickly become familiar. The B. A. committee may make them legal tender among electricians, but will they come to be current coin? Will the success that attended the invention of ohms, volts and amperes be repeated, even in minor degree? Only if the new names allow us to conceive magnetic quantities more easily or to specify them more tersely than we can already do. We are accustomed to say that the permeability of air is 1. Will the advantage of calling it the 'inductivity' instead, and of saying that it is one millihenry per kilometre, be immediately obvious to practical men?

"In some cases it is proposed simply to give a name to the C. G. S. unit, and in other cases to use a multiple of the C. G. S. unit and give that a name. Thus Mr. Evershed would have us call the C. G. S. unit of magnetic induction a 'thom,' while Dr. Lodge would take 10^8 of the same unit and call it a 'weber.' Why do either? So long as we stick faithfully to C. G. S. a number is enough. To say that the total induction through an armature is 25 millions is at least as convenient and precise as to say that it is 25 million 'thoms' or 0.25 'webers.' Dr. Lodge has chosen the magnitude of the 'weber' so that an E. M. F. of one volt shall be excited in a conducting circuit through which the total induction changes at the rate of one 'weber' per second. But this endeavor to connect the new unit with the volt, the ampere and the ohm results in making it inconveniently large. Better, I think, use C. G. S. pure and simple in dealing with the magnetic quantities, and introduce the needful power of 10 when we want to reckon volts.

"Again, we are asked to accept a new name for the line-integral of magnetic force, which most of us (following Mr. Bosanquet) call the magnetomotive force. This quantity is of first-rate importance in relation to the magnetic circuit as a whole. But I doubt if the occasion ever arises in practice to reckon magnetomotive force except for the whole circuit. And so long as we are dealing with the magnetic circuit as a whole it is not likely that any new name will be more serviceable than the familiar and eminently practical 'ampere-turns.' When we want, for purposes of reckoning, to express the magnetomotive force in C. G. S. units, it is easy to multiply by $\frac{4\pi}{10}$; but ampere-turns is too expressive and explicit a phrase to require addition or change.

"As to the magnetic force at any point ($\mathfrak{H}$), no new name is wanted, and the C. G. S. unit is all that could be wished in respect of magnitude.

"I understand that it is proposed to use one and the same unit for the permeance of magnetic circuit and for the self-induction of a coil or the mutual induction of two coils. These are quantities of the same dimension, and as Prof. Lodge points out, the self-induction of a coil of n turns is $4\pi n^2$, the permeance of the magnetic circuit through its coil. Mr. Baily's objection that the self-induction of a coil would be liable to confusion with the permeance of its core has much force. As to permeance, which is total induction divided by magnetomotive force, no special unit name seems necessary. Whether a unit name for self-induction and mutual induction is practically important I have no opinion. The invention and partial use of 'secohm' on this side of the Atlantic and 'henry' on the other suggest that it is. But in any case it would be unfortunate and confusing to give the 'henry' a value different from that which has already been assigned to it. Will American electricians consent to make their old name have a new meaning? Moreover, though this is of less consequcnce, the unit now proposed is like the 'weber,' inconveniently big. These are large prices to pay for the kind of consistency that is aimed at in Prof. Lodge's proposals.

"One or two points may be noticed that have come up incidentally in this correspondence. Prof. S. P. Thompson speaks of the quantity which we write $\mathfrak{B}$ as 'unfortunately sometimes called the induction, as though induction were not the operation of inducing.' I have rarely heard it called anything else, and am content to follow Maxwell, who probably believed that induction, like deduction, might properly name the result of a process as well as the process itself.

"To define μ as $\frac{d\,\mathfrak{B}}{d\,\mathfrak{H}}$ would, in regard to iron, make μ useless. It should be remembered that, owing to the complications of hysteresis, the term permeability as applied to iron has a special meaning. It is used to name the ratio of $\mathfrak{B}$ to $\mathfrak{H}$, when $\mathfrak{H}$ is either (a) applied without previous magnetization, or (b) applied after previous magnetization by an equal and opposite magnetic force. These two definitions do not give strictly the same result; but the values are so nearly alike that the difference is, in practice, unimportant.

"As to Mr. Heaviside's invitation to formulate a theory of the process of magnetic induction in iron, I fear that the relation of $\mathfrak{B}$ to $\mathfrak{H}$ is far too complex—as depending on previous values of $\mathfrak{B}$— to admit of mathematical statement. That at least is the conclusion to which a study of the model with small magnets seemed to point, where the process of magnetization was seen to occur through the breaking up and rearrangement of inter-molecular ties under the influence of the applied field."

Consolidation of Storage Battery Companies.

The Electric Storage Battery Company, of Philadelphia, has absorbed the Bradbury-Stone Storage Battery Company, of Lowell, Mass. By the new arrangement it is stated that the stock of the Bradbury-Stone Company is guaranteed a value above its par by the larger corporation.

The payments for the newly-acquired property are to be made in annual installments, taking the entire profits of the New England business of the Bradbury-Stone Company. A payment of $25,000 is guaranteed in the first two years.

The Tesla Patents in France.

According to *L'Industrie Electrique*, Schneider et Cie, of Creusot, which, in 1893, purchased exclusive rights to the Tesla rotary field patents for France, has entered suit against the French manufacturers of Brown and of Oerlikon motors in France, and against the Lyons representative of the Swiss firm of Alioath, which makes rotary field motors.

Municipal Lighting.

The town council of Exeter, England, has decided to purchase the electric plant of that place, which is now in private hands.

Electrical Ottawa.

THE city of Ottawa is of particular interest to the electrical fraternity at the present time, owing to the approaching convention of the Canadian Electrical Association, which is to be held on Sept. 17, 18 and 19.

At the time of confederation Ottawa was made the seat of government of the Dominion of Canada, although both the cities of Toronto and Montreal were very anxious to secure this honor. Popular expectation in the older provinces was somewhat disappointed at this action of the government, for the newly created capital was considerably out of the way of direct travel between Ontario and Quebec, then called Canada West and Canada East, respectively. The position of Ottawa is, however, on the highway to the great Canadian Northwest and British Columbia. Besides the Canadian Pacific Railway it is connected with Montreal by the Canada Atlantic Railway, and is the terminal point of the Ottawa, Arnprior & Parry Sound Railway and the Gatineau Valley Railway. Besides these railways it enjoys very good steamship service from Montreal, and its shipping facilities are thus excellent.

As the surrounding country was covered with very rich forests and the location of the city is on the banks of the Ottawa River at the Chaudière Falls, where an almost unlimited water power is available, the chief industry of the place has been that of lumbering. The first water power utilized, however, was that of the Rideau Falls, somewhat below the Chaudière, where the Rideau River drops directly into the Ottawa River, a distance of some 40 feet. The settlement was called New Edinburgh, but it is now incorporated in the city. A number of lumber mills and grist mills were located at this point, most of which are still in operation.

The Parliament buildings occupy a most imposing site on the bank of the Ottawa on a rocky prominence about 60 feet above the level of the river; they are constructed entirely of limestone. Their beauty of architecture is well known, and is the pride of every Canadian.

An experimental farm, carried on by the Dominion Government, lies a few miles out of the city. At this farm investigations are continually carried on in all matters pertaining to agriculture and dairying; the institution has also a branch in the Northwest. Reports are periodically published, which are of considerable value.

The population of the city of Ottawa is about 50,000, and directly across the river, in the Province of Quebec, lies the city of Hull, whose chief interests are lumbering and the manufacture of matches, pulp, and wooden ware. With this and the outlying villages a total population of about 70,000 transacts all its trading in Ottawa.

In point of electrical development, the city is among the foremost, if not the foremost, in Canada. Owing to its water-power facilities, electric current can be supplied at very reasonable prices, and is used for a great variety of purposes. In addition to the existing commercial applications of electricity, there are a number of schemes now on foot for its further utilization, among them being that of the Ottawa & Aylmer Railway & Bridge Company. This company was incorporated at the last session of the Dominion Parliament with power to run an electric railway from a point at or near Ottawa to Britannia, a watering place at the foot of Lake Lachine, on the Ottawa River, and to bridge the river at this point; thence to extend along the Quebec bank to the town of Aylmer. Surveys are now being made on the Ontario part of the work, and it is expected that this portion of the line will be built next season. The gentlemen so prominently connected with most of the electric industries of Ottawa also control this charter.

The Ottawa Electric Company.—Electric light, power and heat are supplied to the inhabitants of Ottawa, Hull and the surrounding villages by the Ottawa Electric Company, the present officers of which are T. Ahearn, president; Hon. E. H. Bronson, vice-president; A. A. Dion, general superintendent, and G. S. MacFarlane, secretary-treasurer. This company has only been in operation for a little over a year, having been formed by the union of three separate companies which existed before that time, and has an authorized capital stock of $1,000,000, of which $645,000 is already paid up. Its business is a very extensive one for the size of the place, its incandescent load alone averaging one 16-cp lamp to every inhabitant. The company supplies about 4,550 lamps (in equivalents of 16-cp) on the ordinary commercial and office circuits, all billed at flat contract rates. On meter it has a load of 45,450 lights; the total number of meters in use being 2,200. The arc-light load consists of 75 ten-ampere lamps, for commercial use, and 400 supplied on streets and public squares. On the power circuit are 90 motors, representing a total load of 350 hp in round numbers; one of these, a 100-hp machine supplied from a 500-volt circuit, drives all the machinery in the flour mill of Martin Warnock & Co., and runs without a stop, excepting Sundays. The other motors are all of ordinary sizes, 1½ to 15 hp, and are supplied mostly from a 250-volt circuit. All of these, excepting the 100-hp motor, which is supplied by special contract, are billed at flat rates based on the maximum amount of current consumed. The company intends rearranging its power lines on the three-wire plan, supplying current at a pressure of 250 volts between the neutral and each outside wire, or 500 volts between the outside mains.

Quite a business is done in supplying current for electric heaters, a considerable number of these being used in barbers' shops, bars, etc., for heating small quantities of water; current is also supplied to five stoves and three hot water furnaces. The construction of these heaters is very simple. The water heaters consist merely of cylindrical cans, around which are wound coils of bare iron wire insulated from the cans by very thin porcelain strips; this whole arrangement is encased by a larger cylinder, and the intervening space is packed with loose, non-conducting material. The furnaces are built in the same way. In one case, a drug store about 15 ft. x 60 ft., five water cans holding about six gallons each are arranged in multiple, as shown in Fig. 1, each can having a valve placed in its inlet and another in its outlet. The heating coils wound about the water cylinders, *A*, *B*, *C*, *D*, and *E*, are each controlled by a separate snap switch. Any one of the coils, or any cylinder may thus be cut out, the amount of heat supply is easily regulated, and repairs may be made without shutting down the whole furnace. Mr. Ahearn estimates that the current required to heat these five coils does not exceed six hp. No actual tests have been made.

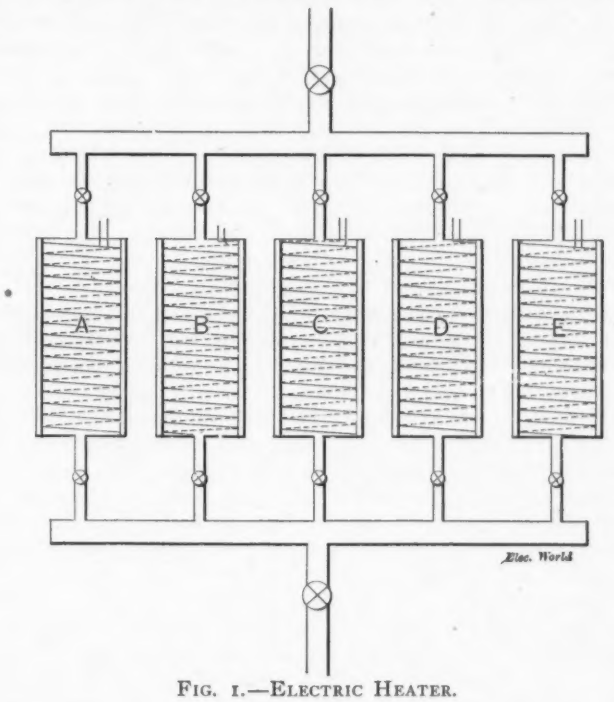


FIG. 1.—ELECTRIC HEATER.

The history of electric lighting in Ottawa dates back to 1881. At that time a wooden tower about 60 feet high, standing on an eminence of about 40 feet, was erected and five 2,000-cp arc lamps placed thereon. This experiment proved unsuccessful and the tower was removed. In 1884 the City Council advertised for tenders to light the streets and public squares. The Royal Electric Company of Montreal and Messrs. Ahearn & Soper, who were then already in business as electrical contractors, were the only bidders. The Royal Company, being somewhat lower in price, were awarded the contract and an agreement covering a period of ten years was entered into. This move resulted in the organization of the Ottawa Electric Light Company, which company continued in business exclusively as an arc lighting company during the whole period of its existence. The company's original agreement with the city was for two hundred 2,000-cp lights.

In 1887 Messrs. Ahearn & Soper organized the Chaudière Electric

Light & Power Company, commencing business in Hull, Quebec, on the opposite side of the river. The first dynamos used were of the old U. S. type, supplying current at a constant potential of 550 volts. Series-parallel distribution thus had to be resorted to, arc lamps being connected ten in series and incandescent lamps five in series. A somewhat novel arrangement of incandescent lamps was employed, two lamps being attached to one socket, the second one being used as a safeguard only and so arranged that it was automatically brought into circuit if the first lamp was disabled. About one year after its incorporation the Chaudière Company moved its power-house to the Ottawa side of the river, and in 1889 alternating-current apparatus was installed. The installation consisted of two 750-light machines. Meters were also introduced at this time, private houses began to take the light, and the output of this station very rapidly increased. All the water-power plants at Ottawa are troubled very much with anchor ice, and in 1892 the directors of the Chaudière Company erected a steam power-house to be employed as an auxiliary in such cases.

The third company to begin business in Ottawa for supplying incandescent light and power was the Standard Electric Company, which was organized in January, 1891. The gentlemen most prominently identified with this venture were the Hon. E. H. Bronson, Mr. G. B. Pattee and others, and Mr. C. Berkeley Powell, who acted as general manager. The company erected a very substantial central station, built entirely of rough stone two stories high and covering a total area of about 150 x 100 feet on Amelia Island. Alternating-current apparatus, manufactured by the Royal Company, was installed. The company also did a considerable business in the supply of electric power.

The amalgamation of these three companies was effected on July 27, 1894. At the same time the city lighting contract was again renewed for a period of ten years. At its formation the new company obtained possession of five different central stations. The rearrangement of these, as well as of the lines, entailed a very great amount of work and is as yet not nearly completed. Mr. A. A. Dion, the able superintendent, has promised the Canadian Electrical Association a paper, to be presented at its coming convention, on the difficulties encountered; the paper will no doubt be a very interesting and valuable one.

Station No. 1 was erected by the Standard Company. Four 66-inch turbines are at present employed, and there is room for a fifth; a head of 28 feet is available at this station. The jack-shaft is located in a single story addition to the main building, running along its entire length and being about 50 feet wide. It is belted to two countershafts located on the ground floor of the main building, which is also about 50 feet wide, the dynamos all being on the floor directly above. The countershafts are fitted with clutches for convenient cross-connection. The electric machinery comprises five alternators, one a 2,000-lighter, the others having a capacity of 1,500 lights each. In addition to these a 300-kw alternator, belted directly to the jack-shaft, is placed on the ground floor. Four direct-current generators of 60 hp each, supplying current to the power mains, are located on the dynamo floor. The old Standard Company lines are still kept separate, but plans are all ready for combining the whole system of mains. This station will be made the principal distributing station, and all the others will be worked as sub-stations, their dynamos being connected to the switchboard here. The company will have a private telephone line connecting all stations for the convenience of the switchboard operator. A new distributing board, 57 feet long, to be constructed entirely of marble and iron and resting on rubber discs, to reduce vibration, is now being put up. The wires will be so arranged that a man cannot receive a shock or burn at the face of the board.

Station No. 2 is the station of the former Ottawa Electric Lighting Company, and will be retained exclusively for arc lighting. Four turbines built at the Baldwin Iron Works, Ottawa, three 66-inch and one 48-inch, are here employed under a head of 24 feet. Rope drives are used to connect the jack and countershafts since the distance between them is small. Eighteen T-H pattern 10-ampere dynamos, built by the Royal Company, and representing an aggregate capacity of about 575 lights, are employed; also one 60-light new type Westinghouse machine, self-regulating and having its fields separately excited. Ten circuits radiate from this station and aggregate over 30 miles of line, the farthest light being four miles from the station.

Station No. 3 is the steam auxiliary station erected by the Chaudière Company. The building, which is an unusually substantial one, is one story high, built of brick, with a trussed steel roof. It is very conveniently arranged; the boiler room is 75 x 45 feet, and the adjacent engine and dynamo room 75 x 85 feet in size. The chimney was built large enough to accommodate another battery of boilers equal to those now installed; it is 120 feet high, 15 feet in diameter at the base and 8 feet across at the top. The steam plant was put in by the Goldie & McCulloch Company, of Galt, Ont. It consists of six horizontal return-tubular boilers 16 feet by 60 inches, having 120 three-inch tubes each, and two Wheelock tandem-compound condensing engines rated at 600 hp each. These are belted to the countershaft, which is also supplied with clutches to cross-connect as desired. Two 240-kw, 1,200-volt Westinghouse alternators of the ironclad, removable-coil armature type, are now located in this station. The exciters are of the type with single field coil. The station has only a dynamo terminal board from which the wires are at present taken to the switchboard in Station No. 5. Scotch steam coal, costing about $5.15 per ton delivered, is used. As this power-house when in use is often taxed very heavily, it is thought advisable to have the best fuel that can be obtained.

Station No. 4, the second station built by the Chaudière Company, has three 48-inch Baldwin turbines operating under a head of 24 feet. The dynamo equipment consists of one 1,500-light Westinghouse alternator, of the smooth-core type, one 120-kw Westinghouse alternator, of the toothed-armature type, and one 100-hp, 500-volt, direct-current generator of the U. S. upright pattern, supplying part of the power lines. Station No. 5, located in the mills of the McKay Milling Company, is the original station of the Chaudière Company. The leads from Stations No. 3 and No. 4 are at present all brought to the switchboard here. The station has two 60-inch and four 48-inch Baldwin turbines, the latter being operated in two sets. Nearly all the old machinery first installed by the Chaudière Company is kept here, but the main part of the work is done by four 750-light Westinghouse alternators.

The turbine governors used at these several stations are those of the Hunt Manufacturing Company, of Orange, Mass.; Fruen, of Minneapolis, and Kennedy, of Owen Sound, Ont., the two former being purely mechanical. These stations are all close together, situated on the several islands in the Ottawa River at the Chaudière Falls.

Mr. J. Murphy is superintendent of the stations, Mr. W. G. Bradley is superintendent of construction and arc lighting, Mr. G. I. Scott is mechanical engineer, and Mr. W. H. Baldwin, hydraulic engineer.

Mr. A. A. Dion, the general superintendent of the company, was born and educated in the City of Quebec. He entered the telegraph service there in 1875 and was afterward engaged in railway service, having been connected with the Intercolonial Railway of Canada, as that company's electrician, from 1889 to 1891. He became connected with the old Chaudière Electric Light Company in 1891, and upon the amalgamation of the different concerns, he was appointed to his present position. Mr. Dion is an engineer of considerable reputation and is a member of the American Institute of Electrical Engineers.

Ottawa Electric Railways.—It is the proud boast of the people of Ottawa that their street railway system stands second to none in America, both in point of equipment and operation. The citizens take a great interest in this road; when an Ottawa man goes abroad he forms his opinion of a street car service by comparing it to that of his native place as a standard of excellence.

The street railway interests of Ottawa are controlled by one company. The cars are operated entirely by electricity by the overhead trolley system and the service is beyond question a good one; the roadbed is smooth and the cars are roomy and comfortable; they are pleasantly warmed in Winter by electric heaters concealed under the seats; they ride easy, are kept neat and clean, and the conductors and motormen are well dressed and well disciplined. The cars go everywhere and everybody rides.

The layout of the road is well planned, as will be seen from the accompanying map; the different lines spread themselves over every part of the city; they extend to the outlying parks and villages and to the government experimental farm. The residential district lying between the Rideau River and the canal is served by the St. Patrick Street line and the Theodore and Rideau Streets loop line; the Elgin Street line extends direct from the heart of the city to the Canada Atlantic Railway depot, while the Wellington and Albert Streets lines lead to the Canadian Pacific depot, the large lumber and manufacturing district situated on the several islands at the Chaudière Falls, and to the town of Hull, on the opposite side of the

Ottawa River, in the Province of Quebec. The Bank Street line extends to Lansdowne Park and Exhibition Grounds, a distance of about two miles from Sparks Street, and the Sumerset Street line is now being extended to the government experimental farm, a distance of three and one third miles from Sparks Street. Rideau Hall, the official residence of the governor-general of the Dominion, and Rockliffe Park is reached over the Sussex Street line, passing through the old municipality of New Edinburgh. Sparks Street is the very centre of the business portion of the city, and all the lines converge here. This arrangement undoubtedly encourages travel; many of our larger railway companies would profit by rearranging their car service as much as possible according to this plan.

Rockliffe Park is a most delightful place for recreation, situated as it is amongst primeval pines on the high bank of the Ottawa River, on the Ontario side, about three miles below the main part of the city. From Rideau Hall outward the railway company has a private roadway winding through beautiful woods along the bank of the river. The company has for the last three summers been running this park as a pleasure ground, and find it a fruitful source of revenue. It has a merry-go-round and other attractions, including bands, in operation every evening and Saturday afternoons during the warm weather. The private roadway and the park are brilliantly lighted with arc and incandescent lights supplied with current from the railway circuit, and the power required to drive the

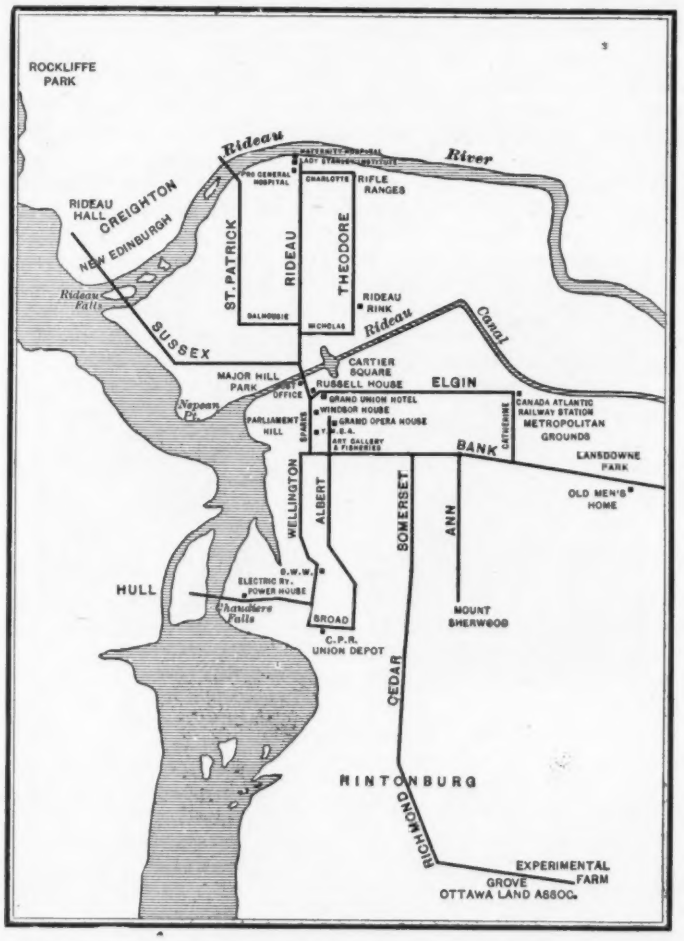


FIG. 2.—MAP SHOWING ROUTES OF OTTAWA ELECTRIC RAILWAYS.

merry-go-round and other apparatus is taken from the same source. The spacious club-house of the Ottawa Canoe Club, lying just below the park, is also lighted by electricity. A very ingenious boat elevator, driven by an electric motor, is here used; the apparatus, which was described in THE ELECTRICAL WORLD of last week, was devised by Mr. A. A. Dion, who is a prominent member of the club, and superintendent of the Ottawa Electric Light Company. It is similar in construction to the ordinary electric elevator machinery, and cuts off the current automatically when the boat carriage arrives at the top or bottom of the slide.

The Ottawa Electric Railway Company is not an old corporation. In 1890 the City Council granted Messrs. Ahearn & Soper a franchise for operating an electric road. They organized the Ottawa Electric Street Railway Company, which was incorporated early in 1891 with an authorized capital stock of $1,000,000, and in June of that year the road was opened for traffic. The Ottawa City Passenger Railway Company, incorporated in 1865, had been in operation since 1870. In 1893, these two companies joined hands, adopting the name which they now carry; they hold a Dominion charter and is the only street railway company in Canada having this. The present paid-up stock of the company is $814,800, with no bonds or other indebtedness outstanding. The officers are J. W. McRae, president; Warren Y. Soper, vice-president; T. Ahearn, managing director; J. D. Fraser, secretary-treasurer, and J. E. Hutcheson, superintendent. The directors are J. W. McRae, T. Ahearn, G. P. Brophy, T. Workman, P. Whelen, Wm. Scott, Warren T. Soper.

The company is working under an agreement with the city of Ottawa for a term of 30 years from Aug. 13, 1893, whereby it pays the city an annual stipulation of $450 per mile of street covered by its tracks during the first 15 years of the agreement, and $500 per mile during the balance of the term; it is not required to pay the city a percentage of its receipts and is exempt from all taxes, except on real estate. Further, the company agrees to remove all snow from the streets occupied by its tracks and the city keeps the streets permanently in repair.

The motive power used is entirely a water power, the plant being located on Victoria Island, at the Chaudière Falls, where a head of 19 feet is secured. The actual fall of the water at this point is about 26 feet, but since the river is subject to heavy freshets the turbines must be placed above the high-water mark to avoid drowning. Four 66-inch turbines, built by Wm. Kennedy & Sons, of Owen Sound, and one of the same size, built at the Victoria Foundry, Ottawa, each rated at 300 hp, drive the generators which supply current to the line. The jack and countershafts are located in the basement, while the three large dynamos are on the ground floor, which covers an area of 50 feet by 95 feet. There are two countershafts, four turbines being belted to one, driving two 400-hp Westinghouse generators, and the remaining two to the other, which drives one 700-hp Westinghouse generator. Hill clutches are used on the countershafts and applied in such a way that the dynamos and turbines belted to the same shaft can be cross-connected as desired. A somewhat novel arrangement of governing is employed, the field coils of the generators being separately excited. For this purpose a separate dynamo of the old U. S. type, driven by an independent turbine, is used to supply current to the three sets of field coils, arranged in parallel, at a pressure of 500 volts, and the fields are thus kept at a constant initial magnetization. To compensate for the armature reactions a certain number of fixed coils in series therewith are, of course, employed. The gates of the turbines driving the generators are operated by hand, while that of the turbine driving the exciter is controlled by a Fruen mechanical governor. The method is found to work exceedingly well, the E. M. F. on the line being maintained at a variation of only 5 per cent., and a number of other important advantages being secured. Though Mr. Ahearn does not claim to be the original inventor of this method, which, however, he devised, and worked it out independently, it is the first instance of its kind of which the writer has any knowledge.

The station is well protected from lightning, six Keystone and 18 non-arcing arresters being attached to the lines. In addition to these a water resistance is tapped across all the feeders as they leave the switchboard. Three impedance coils are inserted in each feeder, and three sets of leads can be taken from behind these into a tank of flowing water which is well grounded.

As a safeguard to be used in case the operator should lose control of the turbine gates, a coil of one mile of No. 6 iron wire is kept submerged in the river. This is connected to an ordinary street car controller, and the gate operator can thus throw any part of this load on the machines. The power-house is under the able superintendence of Mr. T. Lavigne.

The road extends over 17 miles of streets, nearly all of it being double-tracked. There are 29 miles of track; 40-pound T-rails were used at first, but in all the later work 52-pound girder rails and 72-pound high T-rails are put down on the main business streets, and 56-pound T-rails on the outlying districts. Ties are set 2 feet 6 inches between centres and angle fish plates are used. Bonding is done with No. 00 copper wire, cross bonded every 200 feet and connected at intervals to the water mains; where the tracks pass the power-house six No. 0000 copper wires are taken from the rails to the negative leads on the station switchboard. A point worthy of note is that trouble with telephone interference has been fully avoided by putting up a large number of copper aerial return wires in addition to the ordinary returns. These lines are distributed to tap the rails at different points of the city, and vary in size from No. 0000 to No. 2.

No. 0 hard-drawn trolley wire is generally used, though No. 00 is

being put up now on new work; the lines are well supplied with feed ers and the available potential is practically the same at all points.

The rolling stock consists of 39 closed vestibule cars, 28 open cars, three mail cars, five snow-sweepers and three "walkaway" plows. The first cars used were built by Messrs. Patterson & Corbin, of S.t Catharines, Ont.; later ones are all of the Ottawa Car Company's make. Westinghouse double equipments are used throughout. The company claims the honor of having been the first to successfully get rid of the snow, and in Ottawa they have a superabundance of that commodity. When snow begins to fall the sweepers are put on immediately; these are followed by the "walkaway" plows which shovel the snow to the side of the roadway. It is then carted away by horses. During the four years the road has been in operation the cars have not lost a single trip on this account.

The car sheds, of which there are three, are located on Albert Street, each building being 66 x 100 feet, built of brick with iron trussed roofs. The repair shops and a very commodious suite of offices are situated in one of these buildings.

The company transports all mail matter between the post office and railway depots, and carries the city letter carriers under agreement with the Dominion Government. This service was begun in October, 1893, and was the first of its kind on this continent, as is now well known.

The company estimates that it supplies a population of 70,000 persons,—50,000 in the city of Ottawa, 13,000 in Hull, Quebec, and 7,000 from the surrounding villages. During its existence the traffic has been enormously increased. The total receipts of the old horse-car company never exceeded $26,000 per annum; in 1891 the total receipts of the new electric road, which had then just begun operations, were $71,698, while the total receipts of the amalgamated companies for the year ending May 31, 1895, were augmented to $193,991.

When we consider that electric cars were first operated in Ottawa in June, 1891, and that, with the extensions put in this season, there will be 29 miles of rapid transit tracks, covering its principal thoroughfares, we may form some idea of the phenomenal development in street railway matters which has been wrought by electrical science, and it becomes evident that the "deadly trolley" is, after all, an institution of some considerable benefit and comfort to humanity.

Government Inspection of Electric Light.—The Canadian Government holds companies for the supply of light and power under very strict control. Gas companies have for a long time been subject to continual and rigid inspection as to the quality of their product, and in 1894 the Dominion Government passed a law regarding the inspection of electric light. The act was framed largely on the gas inspection act; its requirements are that the variation in pressure at the purchaser's terminals shall not under any conditions exceed 3 per cent. from a declared constant pressure, but this clause is undoubtedly somewhat more rigid than most companies are able to comply with. The lighting companies have raised very strong objections thereto, and it is possible that a larger latitude may be allowed. Meters are also required to be inspected once in five years and stamped with the inspector's stamp; the unit of supply is taken as 1,000 watt-hours or the equivalent thereof in ampere-hours.

Electrolytic meters which were in use at the time the act came into force may be continued unless objected to by the consumers, but new meters of this type are not allowed to be installed, the direct-reading type only being permitted. All electric light companies are required to obtain from the department a certificate of registration, a licence fee of $25 being prescribed. No standard of candle-power is fixed, but the governor-in-council may at any time establish rules for the testing of electric lamps for illuminating power, for instituting tests to determine what style or make of meter shall be used, and for such other regulations as may be found necessary from time to time to give effect to the provisions of the act. It was recognized by the Government that the act would probably be found incomplete or cumbersome in some respects, and it may therefore be changed within the next few years.

Mr. O. Higman, who has long been connected with the telegraph service, as well as with the Fire Underwriters' inspection service, was appointed chief electrician, and has for the first year been busily engaged organizing the electric inspection department. It is intended that the work shall be performed so far as possible by the present gas inspectors, thus lessening very materially the operating expenses of the department. Mr. Higman is a broad-minded man, and recognizes that the provisions of the act are, as yet, in a somewhat crude form, and aims to carry out the spirit more than the strict letter of the law. He is a very efficient officer, of a genial and pleasant disposition, and one whom the companies under his direction all respect.

Ottawa Car Company.—The Ottawa Car Company was incorporated on July 1, 1893, with an authorized capital stock of $100,000, of which $25,000 is paid up. Mr. T. Ahearn is president; Mr. J. D. Fraser, secretary-treasurer, and Mr. W. W. Wylie, superintendent. The concern is an offshoot of the Electric Railway Company. All classes of street cars are constructed, and during the present season the manufacture of other wheeled vehicles has also been taken up. The plant occupies two buildings, each about 66 x 100 feet, in which 30 to 40 men find permanent employment.

The business has been very successful, having yielded a dividend of eight per cent. per annum on the paid-up stock ever since starting. Cars have been shipped to St. John, N. B., Montreal, Oshawa, Galt, Preston, Hamilton and Grimsby, Ont., as well as other places. Nearly all the cars in use at Ottawa were built here. The company intends exhibiting a closed vestibule car at the coming Street Railway Convention in Montreal.

Ahearn & Soper.—The firm of Ahearn & Soper was organized in 1882. Mr. Soper had been manager of the Dominion Telegraph Company and Mr. Ahearn was connected with the Montreal Telegraph Company. He was also manager of the Bell Telephone Company's exchange for a number of years and is still retained by that company as consulting electrician. He is a member of the American Institute of Electrical Engineers.

At the time the firm commenced business there was quite an activity in Canada, both in telephonic and telegraphic work, and they contracted largely in both branches, besides carrying a full line of electrical supplies. They were agents for the old United States Electric Company, for whom they put in many central stations as well as private plants. The firm installed the first electric plant in Ottawa, took an active interest in the formation of the first company

T. Ahearn.

W. Y. Soper.

for commercial electric lighting, and organized the Electric Railway Company. Indeed, both Mr. Ahearn and Mr. Soper are prominently interested in nearly every electrical concern in the city as well as in the allied interests, and the people of Ottawa and its surroundings are largely indebted to the engineering skill, the exceptional business ability and the energetic, progressive spirit of these two gentlemen for the many electrical advantages they enjoy.

They have for some time been the Canadian representatives of the Westinghouse Electric & Manufacturing Company, and have contracted largely for all kinds of electric plants and apparatus for that company. They have equipped about 75 per cent. of the street railways in Canada, furnishing cars, generators and motors, and in some cases supplying the complete equipment. They manufacture transformers, Ahearn heaters, snow-sweepers and switches.

Mr. Charles F. Medbury, who gained a long and varied electrical experience in connection with the Thomson-Houston Company, has charge of the general engineering work of the firm, and attends to its business outside the city of Ottawa.

The Ottawa Porcelain & Carbon Company.—This company was incorporated in February of the present year with an authorized capital stock of $100,000. Mr. T. Ahearn is president of this concern also, and Mr. J. D. Frazer is secretary-treasurer, while Mr. J. W. Taylor, who was manager of the Peterboro Carbon Company, is general manager. The company occupies a large and commodious set of buildings which have just been completed and are located

alongside the Canada Atlantic Railway depot. The works have been equipped with the most improved apparatus.

The porcelain product will consist of door knobs, caster wheels, etc., and insulators, battery jars and other articles utilized for electrical purposes. The carbon works are fitted to manufacture arc light carbons, pressed and moulded, also plates for batteries, motor brushes and other special shapes of carbon used for electrical work.

This factory will have a capacity second only to one in America; it is expected that the carbons will be ready for shipment during the latter part of this month. Mr. Taylor, who planned and built these works, has had a long experience in this business, having been connected with both the National and Standard Carbon companies before he came to Canada.

Another of the prominent electrical houses of Ottawa is that of R. Anderson, electrical engineer and contractor. Mr. Anderson was formerly in the telegraph business, in which he became widely known as an expert operator both in French and English. He was for several years special operator for transmitting French reports from the House of Commons, Ottawa, and subsequently was appointed night wire chief. About five years ago he started in the electrical engineering business, in which he has been no less successful than in his former occupation. It will be remembered that Mr. Anderson was contractor for the Ottawa winter carnival decorations, which included several miles of street illumination and many other decorative features, the success of which attracted favorable comment from all sources.

The Canadian Electrical Association.

F the success which has attended electric development and progress in Canada no small measure is due to the Canadian Electrical Association, which will hold its fifth annual convention in Ottawa on the 17th, 18th and 19th of September. To Mr. S. J. Parker, of Owen Sound, Ont., credit is to be given for having taken the initiative in getting together those interested in electrical affairs in Canada. Toward the close of the year 1890 this gentleman issued a circular to the various electrical companies throughout Ontario asking for certain statistical information relating to the electrical lighting business, and about the same time, impressed with the advantages that would follow an organization of those engaged in the electrical industry, he urged this matter personally whenever an opportunity presented itself.

Mr. Parker's efforts were quickly aided by those of Mr. J. J. Wright, manager of the Toronto Electric Light Company; Mr. C. H. Mortimer, publisher of *The Canadian Electrical News*, and others, and a circular was issued inviting all persons interested to attend a meeting in Toronto during the last week of the Industrial Exhibition of 1891, to consider the advisability of forming an association. A result of this gathering was the appointment of a committee to formulate a scheme of organization and to report at a meeting to be held on the 26th of November of the same year. Twenty-one persons attended this meeting. Mr. J. J. Wright was called upon to preside, and it was decided there and then to organize under the name of The Canadian Electrical Association, and the necessary steps were taken to prepare a constitution and by-laws and complete the organization. Mr. J. J. Wright was elected president of the newly-created association and Mr. C. H. Mortimer, secretary-treasurer.

The secretary reported at the first annual convention of the Association, held in Hamilton in June, 1892, that, though located in a much smaller field, the Association up to that time had made greater progress than the National Electric Light Association of the United States at a similar period of its history. The membership roll at that date included the names of 109 active members, representing very fairly the various provinces of the Dominion.

The enthusiasm with which leading electricians of the country took hold of the work of the Association was the chief element that contributed to its success. Mr. Wright, who held the position of president continuously from the date of organization up to the annual meeting a year ago, is a tower of strength in himself, being a man of great business ability, and having thorough knowledge of electrical affairs, coupled with unbounded energy and interest in the work. He has been untiring in his devotion to Association affairs, and has been ably assisted by Mr. K. J. Dunstan, who was vice-president from the start of the Association until the meeting in September, 1894, when he succeeded Mr. Wright as president.

The Association has been conducted with the one specific purpose of intelligently furthering the electrical interests of Canada, or, to quote from the address of President Wright at the first convention, "To conserve the interests of the industry, both from a commercial and scientific standpoint."

The papers read at the various annual meetings have been of the highest character, such as that on "Long-Distance Telephony," by Mr. Hugh Neilson, of the Bell Telephone Company, and the discussion of central station work by Mr. D. Thomson. Mr. James A. Baylis has talked before the Association of multiple switchboards; Mr. W. A Johnson, at the first meeting, delivered a very valuable paper on the possibilities of electric railroading; Mr. A. B. Smith, who is the electrician of the Underwriters' Association and head of the construction department of the G. N. W. Telegraph Company, was able to impart a great deal of information on safe wiring. And thus one might easily take the various conventions of the organization, and tell of the papers from men like Mr. John Galt, C.E. and M.E.; Mr. E. Carl Breithaupt, Prof. T. R. Rosebrugh, Mr. D. H. Keeley, Mr. John Langton and others, and comment favorably on the ability shown in the papers read and the discussions that follow. "We mean business" could appropriately be adopted as the motto of the Canadian Electrical Association.

The second convention of the Association was held six months after the organization in the month of January, 1893, Toronto being the place of meeting, and there the secretary was able to report that the total membership had reached 119. This meeting was of an especially interesting character from the fact that it met in the building of the School of Science, and coupled with the papers and discussions from those who are engaged daily in the practical working out of electrical problems came supplementary addresses from the professors in the school, whose work, though perhaps of a more theoretical character, is yet very important to the advancement of electrical science.

A convention was held again in September, 1893, in the directors' hall on the Industrial Exhibition grounds, Toronto. By this time the membership had increased to 133, and the finances of the Association were shown to be in a healthy condition. At this meeting the first report of the committee on statistics was presented. This committee, whilst able to furnish important information concerning the extent of the electrical business in Canada, had yet met with difficulties common to such work; many to whom papers of inquiry had been sent, either did not reply at all, or not nearly in full, to the questions asked. The information obtained was, nevertheless, extremely valuable. Another convention was not held for 12 months, and then at Montreal, Sept. 19, 1894. The number of active members on the roll at that time was 99 and associate members 38. The meeting was an important one in many respects, being held in the metropolis of the Dominion and where large developments have been made in electrical matters. At this meeting Mr. K. J. Dunstan succeeded Mr. Wright as president. Mr. Dunstan is local manager of the Bell Telephone Company, in Toronto, has spent a large part of his time in the telephone business, and takes a wide and active interest in everything pertaining to the electrical industry. He has proven a capable successor to Mr. Wright, and at the meeting announced for Ottawa this month, it will be shown, no doubt, that the Canadian Electrical Association has continued to forge ahead under his management.

The following is a list of the papers to be read at the Fifth Convention of the Association:

"Some Notes on the Consolidation of Two Systems of Electric Supply," by A. A. Dion, Ottawa; "The Telegraph in Canada," by Chas. P. Dwight, Toronto; "Suggested Forms for Electric Light Accounting," by D. R. Street, Ottawa; "From the Coal Pile to the Meter," by Jas. Milne, Toronto; "Some Modern Alternating-Current Apparatus," by H. T. Hartman, Peterborough; "Non-Interference Diplex Relay; A Percentage Method for Circuit Measurements," by D. H. Keeley, Ottawa; and a paper by J. J. Wright, Toronto.

During the meeting a number of excursions will be made to view objects of interest in Ottawa and vicinity. On Wednesday evening a banquet will be given at the Russell House, the arrangements for which are in charge of Messrs. Powell and Soper.

The Brooklyn Institute of Arts and Sciences.

Ground was broken on Saturday afternoon for the Museum of Arts and Sciences of the Brooklyn Institute, to be erected on Prospect Hill, east of the reservoir, and facing the Eastern Boulevard. Hon. Frank Squier, park commissioner, presided, and addresses were delivered by Gen. S. L. Woodford and others.

Electricity in Gold Dredging.

BY RALPH L. MONTAGU.

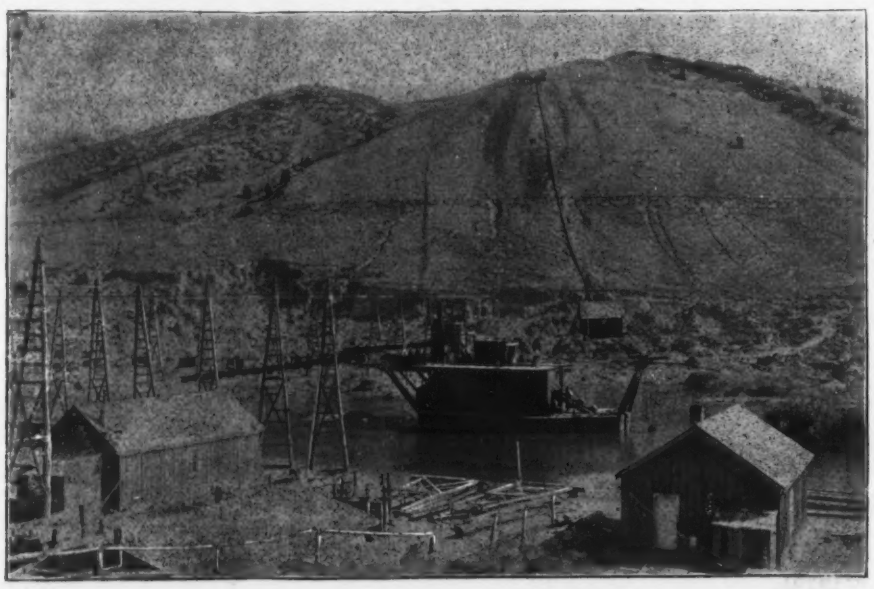
BEFORE I go into the details of the electrical plant furnishing the subject of this article, a brief history and description of this old-time mining camp may not be without interest.

Grasshopper Gulch was discovered in 1862, and the reports of the fabulous richness of its bars brought hundreds of miners and their accompanying horde of followers to the spot. The town of Bannack grew up, became a place of 3,000 inhabitants in a short time, and finally arrived at the distinction of being the capital of the Territory of Montana.

The hillsides and river bars were all thoroughly mined for the precious yellow metal, and have yielded, in the aggregate, $20,000,000; owing, however, to the very slight fall in the river, the actual bed has never been extensively mined, work being confined to a few scattering spots where shafts were sunk to bed-rock, the dirt being hauled to the surface and then washed. This latter is the most expensive method of handling placer claims, but it has always been a paying investment to do so in this district, which of itself speaks for the richness of the ground.

After the first excitement had subsided and most of the traveling miners had moved to fresher fields, Bannack settled back into the town which we find to-day, with about 300 inhabitants, 25 miles from the nearest railway, and with the richest but most inaccessible placer claim in the State, lying in sight of and within easy stone-throw of the town.

It was left to eastern enterprise and capital to devise a method of reaching this gold that lies so near but ye tso far from the eager hands of the never-tiring prospector. The Gold Dredging Company was formed in the Fall of 1894 by Denver capitalists and acquired the Bannack placer claim with its attendant water rights and other privileges. The method of handling the ground was then



General View of Dredging Plant.

decided on, and has been followed throughout with the exception of a few minor changes.

The first piece of work necessary was to dig a ditch large enough to carry the entire water of the Grasshopper Creek, then to build a dam that would give sufficient depth when the river was turned back into its original channel to float a dredge. A smaller ditch, which at that time reached a point two miles south of Bannack, and had been used for hydraulic purposes, was to be extended to a point directly opposite the town, the water from this ditch (300 miner's inches) to be used to give the necessary power to operate the dredge. The dredge was then to dig a pit some 300 feet by 500, the gravel removed to be elevated and mashed in sluice boxes suspended by wire cables at the stern of the dredge, and the railings utilized to build other dams wherever they were needed. As soon as one pit is dug it will be pumped out by means of hydraulic ejectors and the bed-rock then cleaned up by hand, the dredge in the meantime digging another pit farther up stream.

Work was commenced in the Spring of this year, and the dam was completed and the dredge launched on May 15, and operations began June 14.

The boat was built by Mr. H. K. McDonald, of Chicago, and the

Dredging Ditch.

machinery supplied by the Bucyrus Steam Shovel & Dredge Company, of Milwaukee, Wis. The dredge is of the elevator type, and delivers material into a sluice box at the stern of the boat, 25 feet above its water line.

It is arranged to excavate the material in front in order to make its own flotation, the cut being made wide enough to pass the boat through. A centrifugal pumping apparatus supplies water to the sluice boxes. The speed of the buckets is 20 per minute, and the discharging capacity is 220 cubic yards per hour. The bucket chain is composed of 26 links of 26-inch pitch, carrying 26 buckets of five cubic feet capacity each, and fitted with steel bottoms and protected joint connections of moulded rubber.

The material is first passed through a rotary grizzly having five-inch openings, from which two iron chutes lead; one of these discharges the larger stone overboard, the other leads to the back elevator where the material which comes through the five-inch springs of the grizzly is conveyed to the sluice box. The back elevator is similar in construction to the main chain of buckets, but lighter, since it has only to pick up the material delivered by the main chain.

Both chains of buckets and the rotary grizzly are driven by a motor of a capacity to develop 75 mechanical horse-power at the pulley. The type of motor chosen was the L. P. W.-20 railway motor of the General Electric Company. The switches, rheostat, circuit-breaker, and ampere-meter for this motor are located in the pilot-house.

A 15-hp motor is geared to two swinging drums, one on each side of the boat, for the purpose of holding the lines required to swing the dredge.

All switches belonging to this motor are also in the pilot-house. In order to hold the boat in position while working or moving ahead, two spuds, made of Oregon fir 18 inches by 18 inches by 40 feet long, and capped with iron points, are employed, being also operated by a 15-hp motor. The switches for this motor are placed on the main or machinery deck between the spuds, while on either side are the necessary clutches to raise or let fall the spud that needs to be changed. The two 15-hp motors named are of the G. E.-800 type.

A 12-inch centrifugal pump capable of supplying six cubic feet per second into the sluice box, is operated by a motor developing 60

mechanical horse-power at the pulley. The necessary switches, etc., of this motor are placed in the pilot-house.

The pilot-house, from which the operator controls the entire machinery, deserves more than passing mention. The two mains enter from the stern and proceed directly to a main switch located directly in the centre and near the windows that look down at the main chain of buckets. This switch opens or closes the whole of the motor circuits, the lamp circuits being taken from the main wires before they reach this switch for obvious reasons. Directly to the right of the main switch is placed the bucket motor switch, and to the right of that a switch that opens or closes all the lamp circuits. To the left of the main switch is the swinging drum motor switch, and on the wall to the left is placed the pump motor switch and rheostat. The rheostat of the bucket motor and reversing switch are placed in the centre of the pilot-house, the former being boxed in and furnishing an extremely convenient table for any extra testing instruments that are occasionally used.

The wall on the right of the pilot-house is occupied by a meter board. On it are placed four ammeters, one for each motor, and a voltmeter, all of the Weston type, round pattern; also, three circuit-breakers for the bucket motor, pump motor and swinging drum motor, respectively. The circuit-breaker and necessary switches for the spud hoist motor, are on the deck below, as before explained. The lamp circuit switches and fuse blocks are also placed on the meter board, all of the lamp sockets being of the moisture proof type.

A few readings from the different ammeters will be of interest. For instance, the pump motor throws six cubic feet of water per second, at 80 amperes. The G. E.-800 motors require from 15 to 20 amperes each to do their respective amounts of work. The bucket motor takes at times 200 amperes before it starts. The ammeter creeps up slowly as the resistance is cut out; whenever the digging is good, however, the meter reads only from 90 to 110 amperes.

The foundations of the machinery in the power-house are made of concrete placed on a section of bed-rock that rose to a convenient elevation. The equipment consists of one Edison 500-volt 100-kw generator, direct-connected by means of an insulating clutch to a 26-inch Pelton water wheel.

The pipe line is almost straight and but 760 feet long, in which a fall of no less than 330 feet is obtained. The material used was No. 14, No. 12 and No. 10 sheet steel, double riveted and with slip joints; the pipe is 18 inches in diameter and the running pressure 142 pounds per square inch. Great care had to be exercised in anchoring the pipe line, owing to the enormous strains to which it is liable, due to the sudden variations of the load, as the governing is effected by means of a throttle valve.

A two-inch pipe supplies water through a one-half-inch nozzle to a Pelton water motor used to operate the differential governor. The governor consists of two pulleys running loose and in opposite directions on the same shaft. One pulley maintains a constant speed being belted to the water motor; the other pulley is belted to the shaft of the 26-inch water wheel, the speed of which varies according to that of the generator. A mitre gear is attached to each pulley, and these in turn engage two other mitre gears attached to a cross-head on the shaft. As long as both pulleys run at the same speed the shaft remains stationary, but when one pulley runs faster than the other the cross-head and shaft turn in the same direction as that of the faster pulley. This movement of the shaft is utilized by means of a suitable mechanism to open or close a throttle valve placed in proximity to the nozzle of the 26-inch water wheel. By this means the speed of the dynamo is kept practically constant.

The variation of load on the generator is, I venture to say, greater than that of any other plant in the United States. For instance, whenever the dredge gets into very hard digging and gets stuck fast, the pump motor is stopped and the buckets stopped and reversed until they are free once more. While this is taking place the load on the generator varies from zero to full load and back to zero, as often as 15 times in a minute.

Owing to the very slight fly-wheel effect the generator tends to lose its speed or race immediately the load is changed, but the differential governor checks these tendencies in a manner that speaks well for its efficiency.

It need hardly be added that the 100-kw generator which supplies the energy for two 20-hp motors, two 15-hp motors, 10 arc lamps and incidentally a few incandescent lamps, has all it can do to take care of its load.

From the switchboard two 16 x 10 cables, with weather-proof insulation, carry the current to the dredge. The problem of always keeping the dredge in electrical connection with the power-house was solved by constructing a reel to take both cables. The inside ends of each conductor lead out through opposite sides of the reel, and are attached, by means of a set screw, to a flanged sleeve of machine steel, firmly fixed to and insulated from the reel. These sleeves revolve freely on two other sleeves that are attached in like manner to a stationary shaft. Each of these smaller sleeves has a collar turned on it to prevent end play, and also a set screw which holds the terminals of the solid conductors that go direct to the pilot-house, from where, as before explained, the current is distributed to the different motors. Spoke handles are fitted to the periphery of the reel, and the cables can then be wound up or paid out without stopping the operation of the dredge for a moment.

The day the plant started, June 14, a Montana shower was falling, or, as we call it in the East, a snowstorm was raging, but, although the reel is exposed to the weather at all times, there has never been the faintest ground or the slightest short circuit perceptible in it. No doubt some will ask why the reel was not put lower down, or inside the covered portion of the boat. The answer is that by having the reel located as at present, between the spuds, it changes its position with reference to any given point on shore less than if placed at any other point on the boat, and secondly, by having it located as high as possible it allows the boat to swing through its complete range without the cables having to be reeled.

I am indebted to Wm. Jackson, of Bannack, and George J. Henry, Jr., of San Francisco, for the accompanying photographs of the plant and vicinity.

Springfield Meeting of the Society for the Promotion of Engineering Education.

The third annual meeting of the Society for the Promotion of Engineering Education was held at Springfield, Mass., Sept. 2 and 4, just preceding the sessions of the American Association for the Advancement of Science, at the same place, as at Brooklyn last year.

President Geo. F. Swain, in an address opening the sessions, stated that the first and most important object of the society is to enhance the reputation and influence, and even to formulate more definitely the existence of the profession of engineering teaching. The principles governing the teaching of applied science must be in general the same as those governing the teaching of other branches. He wondered how many of the members, before this society was founded two years ago, were members of any educational association. It should be recognized that in engineering education, the important, the controlling factor is education, not engineering, and if it is wished to attain the truest success professors should seek to make themselves, first of all, teachers. The young man who desires to devote himself to the teaching of engineering should avoid a too long apprenticeship in practice, but should rather aim to continue a certain amount of practice along with his teaching. It is suggestive to contrast the schools of to-day and the schools of 25 years ago. We may well be asked whether the success, usefulness and rapidity are proportionately greater to-day than in the past, and the speaker stated that he sometimes feels that the answer must be in the negative. Probably the most promising field open to the society in encouraging individuality in teaching is in regard to entrance requirements, and it may perhaps hope to exert a favorable influence upon preparatory schools in securing more thorough and uniform training than is now offered for students preparing for technical schools.

The paper on "The Scope of an Engineering School, with Especial Reference to Its Assuming Duties Now Left to the Preparatory Schools, and Extending Its Course on the Other Hand to Include Post-Graduate Work," by William G. Raymond, of Rensselaer Polytechnic Institute at Troy, N. Y., brought out a great deal of discussion, most of it contrary to the views of the speaker. The last paper of the morning was on "The Present Requirements of American Engineering Schools in Non-Professional Studies," by Louis E. Reber, of Pennsylvania State College.

MONDAY AFTERNOON.

In the afternoon the first paper was read by Prof. M. E. Wadsworth on "Elective Studies in the Michigan Mining School." Following this was a paper on the use of the graphical methods in general, by Prof. L. M. Hoskins, of the Stanford University of California, in which the question was discussed as to how far these should be carried. "Specifications for Text-Books," by I. O. Baker, of the Uni-

versity of Illinois, called forth some discussion, but in the main the argument of the writer for condensation of engineering books to handy pocket size was commended. The last paper, abstracted in our issue of last week, was on "The True Place of Drawing and Shopwork in Engineering Schools," by Prof. C. H. Benjamin, of the Case School of Applied Science, of Cleveland, O., after which the society adjourned to attend the reception at the Armory, given by Colonel and Mrs. Mordecai.

TUESDAY MORNING.

The first paper was on "Graduation, Theses and Degrees," by Storm Bull, of the University of Wisconsin, Madison, Wis. This was followed by one on "Modified Requirements for Graduation of Students Who Have Taken Full Literary College Courses," by Ira N. Hollis, Harvard University, Cambridge.

Prof. William H. Burr, of Columbia College, presented a paper on "Comparative Values of Graduate Study in Engineering Courses," and L. S. Randolph presented a paper on "The Economic Element in Technical Education." In the latter paper the author laid stress upon the fact that many graduates of technical schools when entering upon actual business have displayed an inability to economize in the way of the selection of materials to be used in working out their plans. He spoke also of the loss of time in the working out of complex formulas, and said that oftentimes too much accuracy and nicety of refinement does as much harm as the lack of all accuracy. In closing the paper, the author expressed it as his opinion that the place to counteract this evil was in the schools, by giving the students while pursuing the regular course a chance to do practical work beside.

The next paper presented was on the "Unsymmetrical Development of the Various Courses in Engineering," by F. R. Hutton, of Columbia College.

The last paper presented was entitled "The Engineer of the Twentieth Century," by E. L. Cortbell, of Chicago University. The paper states at the outset that it is neither a technical, professional, scientific, nor even an argumentative paper, but rather an earnest personal appeal to the engineers of the twentieth century, who are to take up and go on with the work, which we of the nineteeth century must so soon lay down forever.

In his recent address before the American Society of Civil Engineers, President Morrison sketched in clear outlines, and filled in the picture with striking but true colors, the civil engineer of the twentieth century, and more than that, he surveyed in a masterly manner and attractive style the field of his labors and set before him a goal for his highest ambitions. As a secondary and developing text the main features of the fundamental advice of President Morrison's address are here recorded: "The civil engineer of the new epoch, the epoch which he is bringing into existence by the manufacture of power, must be an educated man; in no profession will this be more necessary. The civil engineer of the new epoch must be a specialist. No man can learn to design all the tools of which the powers in nature are to be directed. The work is too great for any one man to master. The best results will only be obtained by concentrating effort in a single line. But though the civil engineer must be a specialist, his speciality must not be of a narrow kind; he must have a general knowledge and training which makes the liberally educated man."

In connection with the presentation of the papers a short business session was held, at which the following were elected members of the council for three years, to fill the vacancy caused by the retirement of the seven members, whose term has just expired: Mansfield Merriman, of South Bethlehem, Pa.; William G. Raymond, of Troy, N. Y.; C. F. Allen, of Boston; R. S. Woodward, of New York; Cady Staley, of Cleveland, O.; C. L. Mees, of Terre Haute, Ind.; J. M. Ordway, of New Orleans.

TUESDAY AFTERNOON.

No afternoon session was held, but instead the members of the society made a trip through Holyoke, leaving this city at 1.40 and arriving at the office of the Water Power Company in Holyoke at 2.48. A special electric car carried the party and furnished means of transportation around Holyoke. At the Water Power office they were met by President Wells, Treasurer Waters and Engineer Sickman, who took them through the office. From there they were taken to the site for the new dam and watched the workmen for some time. The testing flume of the company was also visited. The party then went to the mill of the Beebe & Holbrook Paper Company, where they were met by the officers of the company. The mill was inspected thoroughly and the party expressed its satisfaction with the way that paper is made in this mill. A delegation from the party also went to Mountain Park, where they were given a view of the surrounding country.

WEDNESDAY MORNING.

The reading of papers was preceded by a brief business meeting, during which these officers for the coming year were chosen: president, Mansfield Merriman, of Lehigh University; first vice-president, F. O. Marvin, of Kansas State University; second vice-president, Cady Staley, of the Case School of Applied Science; secretary, C. F. Allen, of the Massachusetts Institute of Technology; treasurer, J. J. Flather, of Lafayette, Ind. E. L. Carthell and E. L. Farwell were elected to membership in the society.

The session was a long one, the papers being read by the authors: "Physics," C. T. Mees, of the Rose Polytechnic Institute; "Civil Engineering of One Course," C. L. Crandall, of Cornell University; "Geodetic Engineering," Mansfield Merriman, Lehigh University, and "Sanitary Engineering," by Charles C. Brown, City Engineer of Indianapolis.

Prof. Brown's paper was in the nature of good advice to young men about to study engineering. He sarcastically referred to the "young man, now so numerous, who is fresh from engineering college, and thinks he has nothing to learn after he has had a few days' practice."

Prof. Brown emphasized the statement that for the colleges with which he is acquainted he should much prefer to have a student take about three and one third to three and one half years of the regular scientific training of a general engineering course with the addition of more "general culture" work, and then spend about one to one and one third years on the special work of the sanitary engineer with a minor subject in the general line. The time can be more conveniently arranged in many cases if the course is a continuous one, and the student elects his specialty early in the course, and chooses his work at the times and in the amounts to make the best combination.

The talk of a general course being the best, because a young man never knows what branch of engineering he is likely to get into, is getting out of date in this day of specialization, and Prof. Brown believes in such special courses, added to the groundwork which gives the college man his culture, and which every college man should have, whether in a classical, scientific or technical line of work.

The first three to three and one half years of a college course should be designed principally to give the student the ability to think, to use his tools, and the last year or so may then be used in teaching him to apply his tools to the special work he proposes to do in life. Prof. Brown finds it impossible to do both of these things in a four years' course in the ordinary college with students of the usual training at entrance, and believes that it cannot be properly done in any school with which he is acquainted in less than four and one half years, and in many cases five years should be spent. Better yet would be the result if about two years were spent in the training of the mind to know its powers before any material amount of special work of any sort was entered upon, and then three years of the general technical training and special work, accompanied by a minor study of the "general culture" class.

These papers were sent in to be read by the secretary: "Mechanics," R. S. Woodward, New York; "Astronomy," G. C. Comstock, of Madison, Wis.; "Biographical Studies for Engineers," C. W. Hall, and there were discussions on "Civil Engineering in Specialized Courses," "Structural Engineering" and "Railway Engineering."

WEDNESDAY AFTERNOON.

The first paper in the afternoon was by H. W. Spangler, of the Pennsylvania University, on "Mechanical Engineering," which is printed in abstract in our issue of last week.

"Electrical Engineering" was treated by D. C. Jackson, of Madison, Wis.

George D. Shepardson, of Minneapolis, Minn., had for a subject "Teaching Industrial Applications of Electricity," which is printed in abstract in our issue of last week.

The following papers were then read by title by the secretary "Mining Engineering," by Regis Chauvenet, of Golden, Col.; "Mining Engineering Laboratories," by H. O. Hoffman, of Boston; "A Course of Instruction in Engineering Materials," by J. B. Johnson, of St. Louis, Mo.

The Invention of the Electromagnetic Telegraph—V.

BY A. M. TANNER.

THE illustrious Arago[1] in his review of the discoveries of Herschell, laid down the principle that there is only one rational and just way of writing the history of sciences, and that is to rest exclusively on publications having a definite date; otherwise, he says, everything is confusion and obscurity.

By a publication Arago says he means any academic lecture, any discourse delivered before a considerable audience, and every reproduction of the thought by the press. Private communications, he adds, do not possess the necessary authenticity, and certificates of friends are without value, as friendship often lacks enlightenment, and a friend allows himself to be fascinated.

The present writer in attempting to give an impartial review of the early history of the electromagnetic telegraph as revealed by French records and publications, intends to adhere strictly to the above expressed opinions of Arago, with the addition that patents will also be considered as publications in the sense contemplated by Arago.

A celebrated historian of the electrical sciences, Du Moncel, is cited as an authority that patents accessible to inspection by the public, although not printed, are nevertheless publications to fix or determine the date of an invention.

It was on the 18th day of August, 1838, that Prof. Morse applied for a French patent for his system of telegraphy based on electromagnetism, and in this patent, which was signed and delivered in October, 1838, appears for the first time an illustration of the alphabetical code, formed by dots, dashes and spaces. A complete description of the Morse telegraph, with its underlying principle of the use of an electromagnet and armature in connection with a predetermined code of signals, does not appear to have been accessible to the general public until Oct 30, 1838. Many writers on the history of the telegraph fix Sept. 10, 1838, as the date of the earliest public disclosure of the Morse telegraph, because on this date it was exhibited before the French Academy of Sciences. The description in the *Comptes Rendus* refers to the code of signals made up of dots, dashes and spaces, but the special grouping of such dots, dashes and spaces, which constitute the Morse telegraphic code, does not appear to have been publicly known until the delivery of the French patent. It is unnecessary to reproduce at length the entire French patent, because most all text books and numerous magazine articles have sufficiently made known the earliest forms of telegraphic instruments devised by Morse. The present article, so far as the original French patent of Morse is concerned, goes no further than to show by a photographic reproduction of one of the sheets of the drawings that the alphabetical code as it exists at the present day is embodied in Morse's original French patent. It has been held that Morse never contemplated an acoustic telegraph, or the reception of dispatches by sound, and that he invariably used mechanical means for opening and closing the circuit to operate the armature of the receiving instrument. While it is true that the original French patent brings into prominence as an essential feature of the inventions the recording of the dispatches upon a traveling strip of paper, still it is evident that as early as the date of the original French patent, Morse contemplated receiving dispatches altogether by sound, because one of the claims is as follows:

"The combination and arrangement of electromagnets in one or more circuits of metallic conductors, with armatures for transmitting a correspondence either by signs or by sounds, or by both of these means, at the same time between distant points."

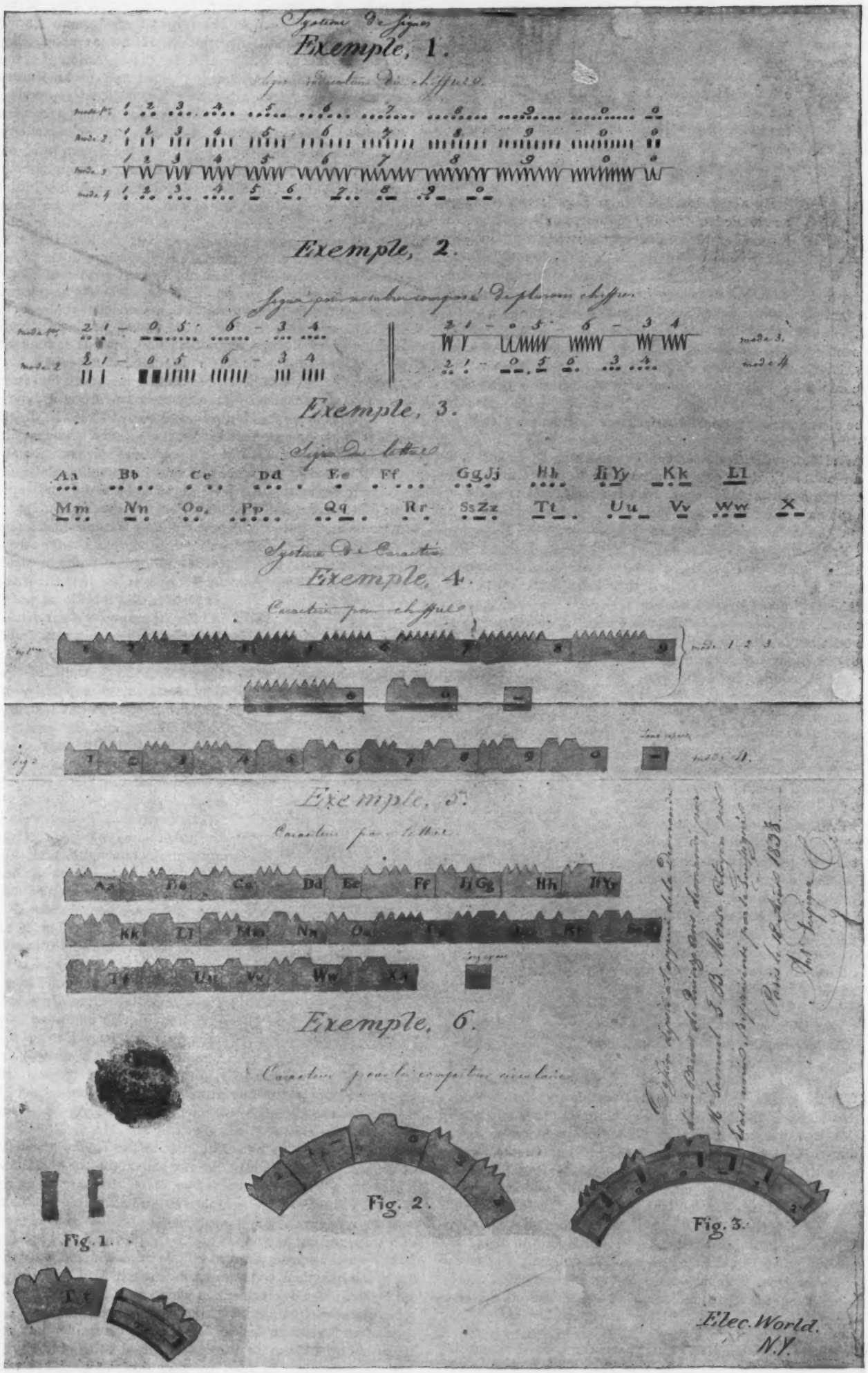
ARAGO.

It was not, however, until Oct. 23, 1838, that Morse, in an additional patent, joined to the original one as an improvement, gives for the first time a description of an acoustic telegraph, in which the signals are transmitted by the operation of a finger-key. This additional patent, which was issued and became accessible to the public on or soon after Dec. 20, 1838, is reproduced *in extenso*, together with the sheet of drawing which accompanied the description. It is evident that this drawing was made by Morse himself, because it is mostly done in water colors and shows the work of an artist, rather than of a mechanical draughtsman, and at the right-hand corner of the drawing Morse fixed his initials, artist fashion. It is known that Morse was in Paris in the Summer and Autumn of 1838, and hence this is proof that everything contained in the additional patent was invented by Morse and that none of his mechanical assistants in America had any share in the invention. It does not appear that this additional French patent of Oct. 23, 1838, was ever referred to in any publications on the Morse telegraph. It is now used for the first time to refute the assertion that Morse considered the recorder an indispensable part of his telegraph, and that he never contemplated receiving signals by sound, or had not an early conception of the applicability of his alphabetical code to an acoustic telegraph. It has also been held that Morse never had in view any other mode of transmission than by the port-rule and type method, but it appears beyond a doubt that as early as 1838 he described the idea of a finger-operated circuit-breaking lever. The specifications[2] of the additional French patent have been translated as literally as possible, and, although it may be said that the bell and hammer arrangement shown in the drawing is unsuitable for the reproduction of the Morse code, still it follows from the description that the construction shown in the additional patent was intended to be applied to the system described in the original patent for transmitting signals represented by a different number of hammer strokes on a sonorous bell. The primary object of the closed-circuit arrangement, set forth in the additional patent, was a railway signaling system, in which the number of the train was indicated by striking a different number of strokes on a gong, but the preamble of the description refers to the capability of the arrangement to transmit instructions and orders throughout the entire length of the line, or to all the stations, and this, as is stated toward the end of the description, by operating the circuit-breaker by hand.

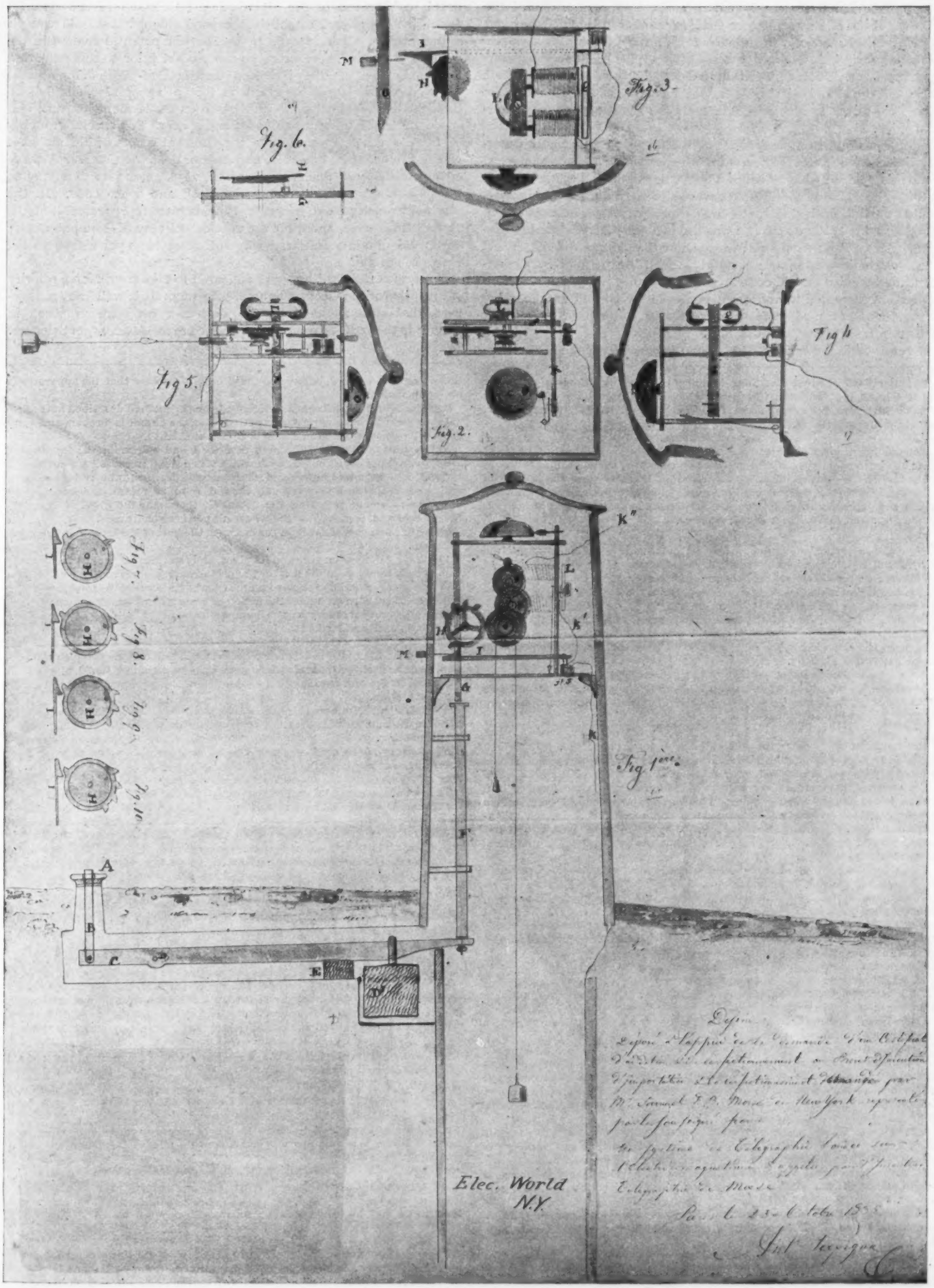
The Morse telegraph system involving the use of a finger-key as the transmitter, and an electromagnet and armature as the receiver, has been held as being something not contemplated by Morse and as having been invented by others subsequent to 1838. The French additional patent of Morse shows that as early as that year, the feasibility of working a telegraph by a hand lever was set forth, and there certainly is a clear description in this additional patent of a telegraph for transmitting instructions and orders along a railway, consisting essentially of a finger-key for opening and closing the circuit, thereby causing the armature of an electromagnet to strike predetermined signals on a sonorous body. As has already been stated, it is doubtful if the signs of the Morse alphabet could be received by the gong and indicated to the ear by the arrangement of the electromagnet and armature shown in the additional patent. There is, however, every reason to believe that as early as 1838 Morse had in view a telegraph system in which predetermined signals were received on a gong or sonorous body by the manipulation of a transmitting key depending upon the skill of the operator. It has recently been stated that Morse did not invent the dot, dash and space alphabetical code, and that Alfred Vail was the creator of said code. The evidence upon which this assertion rests is of the exact nature condemned by Arago as being worthless to prove the date of an invention, and it is rather remarkable that Vail himself never set up a claim to the invention of the alphabetical dot, dash and space code. In fact, we find that Vail, in his work on the "American Electro-Magnetic Telegraph," printed in 1847, says that

[1] Dominique Francois Jean Arago. Born Feb. 26, 1786; died Oct. 2, 1853.

([2] For Note see page 320.)



Drawing, Dated Aug. 18, 1838, Accompanying Morse's Original Application for a French Patent.



DRAWING, DATED OCT. 23, 1838, ACCOMPANYING MORSE'S APPLICATION FOR A "BREVET D'ADDITION."

the alphabetical code was invented by Prof. Morse, on board the *Sully*. It is, of course, known that the earliest telegraph operated by Morse in New York, in the year 1837, formed zigzag lines on the traveling strip and required the use of a special dictionary to interpret the signs. It has been contended that Morse could not have have had the alphabetical code in view as early as 1837, because he would in such case have selected the alphabetical, and not the numerical, code.

Morse himself, in a pamphlet published in Paris during the International Exhibition of 1867, explains why he made use of the numerical code and devised what he called the "artist's frame" telegraph. It has also been stated that Morse never set up a claim to having originated the dot, dash and space code. In the pamphlet referred to Morse distinctly states that he was the inventor of the code in question. There is no valid evidence to show that Morse did not invent the alphabetical code, and certainly Alfred Vail cannot be considered the inventor of said code in the face of his published assertion that Morse invented it, and there is absolutely no evidence to show thet Morse has made a false claim to the dot-and-dash alphabet shown in his French patent of 1838.

Even though the earliest date of the conception of the Morse telegraph making use of the alphabetical code may forever remain in doubt, it is true and established beyond a doubt that said code is represented in all its details in the French patent delivered in the autumn of 1838. There exists no description prior to this date, and the committee of the Franklin Institute of Philadelphia, who reported on the Morse telegraph in the spring of 1838, simply said that the alphabetical code was based on the elements of time and space and made up of dots, dashes and spaces. The special grouping of these symbols to constitute the different letters of the alphabet was not referred to, however, and neither does the *Comptes Rendus* of the Academy of Science of Sept. 10, 1838, enter into details as to the precise composition of the dot, dash and space code. In the original French patent, however, is a complete representation of the alphabetical code, and after the date of delivery of said patent any one could obtain a full knowledge of everything pertaining to the Morse telegraph.

No serious claimant has ever appeared to take from Morse priority of invention of the electromagnetic telegraph. It is well known, however, that electric telegraphs of various types were proposed in France in the years 1837-38, and submitted to the Academy of Sciences.

(*To be continued.*)

---

[1] Application for Brevet d'Addition for improvements upon the original patent dated Aug. 18, 1838, by Samuel F. B. Morse, professor at the University of the City of New York, for a System of Telegraphy Based on Electromagnetism, called the Morse Telegraph.

INTRODUCTION.

The modifications of the apparatus described in the original patent have for their object to adapt the same for service on railways, in such a manner as to make known the position of each locomotive and train of cars on the road on which they are traveling; to indicate successively the different stations to which they come, and to *transmit instructions and orders throughout the entire length of the line or to all the stations.*

DRAWING.

Figure 1 is a vertical elevation of the electromagnetic telegraphic apparatus for transmitting orders and instructions on railways.

Figure 2 is a bird's-eye or top view of the same apparatus.

Figure 3 is a vertical elevation of the apparatus seen at the side opposite to that represented in Figure 1.

Figure 4 is a side view of the same apparatus taken at the right side of Figure 2.

Figure 5 is a side view of the same apparatus taken at the side opposite to the one shown in Figure 5.

Figure 6 is a detail view of the detent.

Figures 7, 8, 9 and 10 are wheels, the first having one tooth, the second two teeth, the third three teeth, the fourth four teeth, without counting a starting tooth which exists on all the wheels.

DESCRIPTION.

A is a section of the rail with which the apparatus is connected.

B is an iron rod passing through a mortise made in the rail; said rod is jointed at its lower end to the horizontal lever *C*.

C is a horizontal lever having its centre of motion on a bolt or pivot of iron resting in bearings of wood or stone. This lever is provided at its end with a weight, *D*, which forcibly maintains said lever on its support, *E*, in such a manner that a light pressure, such as that exerted by the foot of a person, will not deflect the rod *B*, and by raising the lever *C* put the mechanism in operation, as hereinafter described.

F is a vertical lever pivoted to the end of the lever *C*; the lever *F* plays in guides fixed to the wall of the apparatus.

G is a detent which does not touch the lever *F*, and is provided with a stop, *a*, which opposes itself to the passage of a lug carried by the wheel *H*.

H is a wheel with a number of teeth equal to the number of the station where it is located; a first tooth arranged in advance of the others serves to put the apparatus in operation.

I is a *forked lever* already *described* in my *original* patent.

J J, small cups for receiving the mercury.

K K, the conductor coming from one of the poles of the generator and terminating at one of the mercury cups.

K', conductor starting from the other mercury cup and communicating with the electromagnet *L*.

L, the electromagnet, one end of which communicates with the conductor *K'*, the windings of which all encircle said electromagnet; the end of said conductor, *K''*, thereupon passes in the same manner to a second electromagnet, and so in succession to the last one, and thence this conductor returns in a straight line without interruptions to the second pole of the generator, with which it is placed in communication.

M is a pivoted latch which serves to *interrupt the circuit at will*; to this effect the *knob of the latch is raised*, thus depressing *one end and raising the opposite end of the forked lever I, and interrupting the communication.*

N N N, series of gear wheels similar to those of a clock put in motion by a weight and cord. A spring enclosed in a drum can be used for the same purpose.

The wheel *N*, which turns slower than the others, operates the wheel *H* by means of a pinion, *H'*, connected with said wheel and mounted on the same shaft.

O O, gong on which strikes the hammer *P*.

Q, armature of the electromagnet mounted on a lever, *R*, which has its centre of motion on the bar *S*.

OPERATION.

Before describing the operation of the apparatus I consider it proper to remark that in a state of rest the electromagnetism is in circulation throughout the entire line, and it is only when the circuit is broken that the apparatus is put in operation.

It is this which constitutes a difference from the method described in the first patent in which the apparatus is inactive when the circuit is broken, and only operates when the communication is re-established.

An apparatus like the one above described and shown in the drawings is located at all points of the line with which it is desired to establish a communication. When the locomotive and its train have depressed the rod *B* the same will cause the lever *C* to work and the rod *F* to be raised, the latter in its upward movement releasing the detent *G*; thereupon the wheel *H*, being no longer retained, is moved by the wheel *N* and turns on its axis.

Its teeth come successively in contact with the heel of the lever *I* and depress the same.

The lever *I* thereupon turns on its pivot, and the fork, carried at its opposite end, is withdrawn from the mercury cups, the galvanic current ceases to pass into the conductors, the electromagnet loses its attractive force, and the armature is withdrawn under the action of a spring. This movement of the lever gives every freedom to the hammer *R*, which it held upraised, and the latter falls back and strikes the bell.

Each tooth of the wheel will thus cause the hammer to strike once.

Every time the rod *B* is depressed the wheel *H* makes one complete revolution, and the first tooth of this wheel determines a hammer stroke on the bell. This first stroke serves to invite the attention of the person charged to receive the information.

A brief silence follows this first stroke, and the following stroke or strokes indicate the number of the station or the point of the line where the locomotive is passing.

By means of the latch M as many strokes as desired can be sounded at any point where an apparatus like the one above described is located, for transmitting all signals that the exigencies of the service may require.

The same means can be applied to the system described in the original patent for transmitting signals represented by a different number of *hammer strokes on a sonorous bell.*

When it is desired to preserve the traces of the transmitted signals the register described in the original patent is employed.

In this case the conductors are arranged in such a way as to put the said register in motion upon the release of the first tooth of the wheel *H*. This tooth produces this effect besides the one above referred to.

Signals can also be transmitted by using the hand for immersing the fork-carrying lever into the mercury cups and withdrawing it from said cups. But preference is given to the mechanism described by me since the movements thereof are more regular.

The escapement system is combined in such a way that after the wheel *H* has been set in motion by the rod *B*, this rod can move up and down without detriment to the movement of the wheel, so long as the same has not completed its revolution, and by this means an entire train can pass over the rod without in the least changing the indications determined by the passage of the locomotive.

Executed at Paris, Oct. 23, 1838. A. PERPIGNA.

Following are transcriptions of the reports advising the grant of the original and the additional patents:

MINISTERE DES TRAVAUX PUBLICS, DE L'AGRICULTURE ET DU COMMERCE.
COMITE CONSULTATIF DES ARTS ET MANUFACTURES,
Seance du 15 Septembre, 1838.

Rien ne s'oppose a la delivrance du brevet d'invention de 15 ans demande par le M. Morse pour un appareil perfectionne de telegraphie fonde sur l'electromagnetisme.

sig. GAY LUSSAC.
sig. TH. RIVARD DE CLICHY.
sig. SCHLUMBERGER.

MINISTERE DES TRAVAUX-PUBLICS DE L'AGRICULTURE ET DU COMMERCE.
COMITE CONSULTATIF DES ARTS ET MANUFACTURES.
Seance du 1 Decembre, 1838.

Rien ne s'oppose a la delivrance du certificate d'addition demandee par le M. Morse et faisant suite au brevet d'invention de 15 ans qu'il a pris le 18 Aout dernier pour un appareil de telegraphie au moyen de l'electromagnetisme.

sig. SCHLUMBERGER,
sig. GUICCIOLI,.
sig. JAQUIER.

Electrodynamic Machinery—XLVIII.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

365. It sometimes becomes necessary to design a motor, whose speed shall be proportional to the current strength passing through it. This problem arises in devising motor meters for determining the quantity of electricity supplied to a customer from a pair of constant-potential mains, as in electric lighting. The motors employed for this purpose are of very small sizes. We propose to consider the conditions under which the speed of the motor shall be proportional to the driving current strength.

366. Fig. 218 represents a pair of constant-potential mains, marked

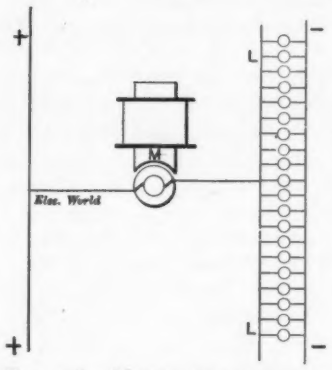


FIG. 218.—MOTOR ARMATURE IN CIRCUIT WITH INCANDESCENT LAMPS.

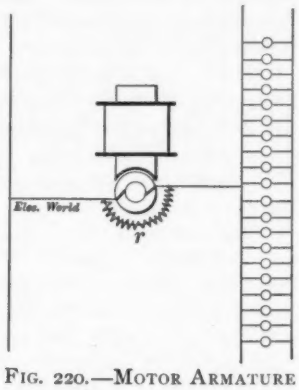


FIG. 220.—MOTOR ARMATURE SHUNTED AND IN CIRCUIT WITH INCANDESCENT LAMPS.

+ and −, with a small motor M, designed to measure the current strength supplied to the incandescent lamps, LL, with which it is connected in series. It is evident that the current which passes through the motor armature will vary directly with the number of lamps which are turned on. The connections of the motor field magnets are not shown. These magnets may be constantly excited from the mains, thus virtually constituting a separately-excited field, or a permanent magnet field may be employed for this purpose. In either case, the strength of the field flux may be considered as independent of the load.

367. We know that (Sec. 288) if i be the current strength passing through the armature in amperes, Φ the field flux, in webers, usefully passing through the armature, and w, the number of turns on the armature, counted once completely around, the torque per ampere which will be exerted about the armature shaft will be

$$\tau = \frac{\Phi\, w}{10.2\,\pi} \text{ cm-dynes per ampere.}$$

If no load except friction were imposed upon the armature, that is to say, if it were free to run without retarding torque beyond a frictional torque of f, cm-dynes, due to mechanical and electrical frictions, then the speed which the motor would attain, as soon as the first lamp was turned on, would be very great, assuming that the torque $i\tau$ was sufficient to start the motor, for the friction f would be practically constant at all speeds, and if $i\tau$ be greater than f, the accelerating force being greater than the retarding forces, will continually increase the speed of the motor until the C. E. M. F. of the armature reduces the current strength to that which is needed to exactly neutralize the retarding torque. Such a small motor, therefore, if unloaded, would tend to run at a very high speed and to reduce the pressure at the terminals of the lamp.

368. It is also evident that the resistance of the armature must be sufficiently small, in order that the drop and C. E. M. F. in the armature, produced by the full-load current, shall not be greater than say one per cent. of the total pressure at the mains. Let us assume that we are able to impose a load or torque upon the motor proportional to its speed. If n be the number of revolutions per second made by the motor, τ, the load torque in cm-dynes will then be $\tau = a\,n$, where a is a constant quantity. Under these conditions, the speed which the motor will attain will be determined by the equality of the driving and resisting torques or $i\tau = a\,n + f$. From which

$$n = \frac{i\tau - f}{a} \text{ revs. per second } = \frac{i\,\tau}{a} - \frac{f}{a}.$$

369. For example, suppose a small motor to be connected as shown in Fig. 218, in circuit with 20 incandescent lamps, each taking one half ampere from a pair of mains supplied with 110 volts pressure. The full-load current will be 10 amperes, and, if the resistance of the armature be 0.1 ohm, the drop of pressure in the armature at full load will be one volt. If the torque, τ, of the motor be 200 centimetre-grammes, or approximately 200,000 cm-dynes per ampere of current, also if the torque due to frictions be 75 centimetre-grammes, or approximately 75,000 cm-dynes, and the torque due to load be 120 cm-grammes, or approximately 120,000 cm-dynes per revolution per second, then, if one lamp were turned on, the current through the armature would be 0.5 ampere. The starting torque would be 100 centimetre-grammes, the resisting torque of friction 75 centimetre-grammes, and the motor would therefore start under a resultant torque of 25 centimetre-grammes. It would accelerate until a speed of 0.21 revolution per second was attained, when the resisting load torque would be $0.208 \times 120 = 25$ centimetre-grammes. Proceeding in this way, we can determine what the speed of the motor would be with any current strength as follows:

Lamps.	Current amperes.	Moving-Torque cm-grammes.	Resisting Friction cm-gms.	Torque Speed cm-gms.	Speed of motor rv. per s.	Speed per lamp rv. p. sec.
1	0.5	100	75	25	0.21	0.21
2	1.0	200	75	125	1.04	0.52
4	2.0	400	75	325	2.71	0.677
6	3.0	600	75	525	4.375	0.729
8	4.0	800	75	725	6.04	0.755
10	5.0	1,000	75	925	7.71	0.771
12	6.0	1,200	75	1,125	9.375	0.781
14	7.0	1,400	75	1,325	11.04	0.789
16	8.0	1,600	75	1,525	12.71	0.794
18	9.0	1,800	75	1,725	14.375	0.799
20	10.0	2,000	75	1,925	16.04	0.802

Here $a = 120{,}900\ \tau = 200{,}000\ f = 75{,}000$,

so that with $i = 20$, $n = \dfrac{10 \times 200{,}000 - 75{,}000}{120{,}000} = 16.04$.

370. It will be observed that, after the first two lamps have been lighted, the speed of the motor is nearly proportional to the number of lamps, and, therefore, the total number of revolutions of a motor armature in a given time will be an approximate measure of the total quantity of electricity supplied through the meter in coulombs, or in ampere-hours.

In order that the error introduced into the indications of the meter by constant friction of the armature shall be as small as possible, it is important that the constant torque per revolution per second shall be as great as possible, relatively to the friction, or that $\frac{f}{a}$ shall be a small fraction.

371. In practice it would be very difficult to arrange a motor of this kind, having its armature directly in the main circuit of the lamps, for the reason that if the brushes were sufficiently fine to permit the friction of the armature to become negligibly small, any accidental short-circuit, occurring between the lamp-leads, would probably destroy the brushes or armature, or both. The problem has, however, been successfully met in practice by making the armature in this case the fixed element of the motor, and the field magnet of this case the moving element.

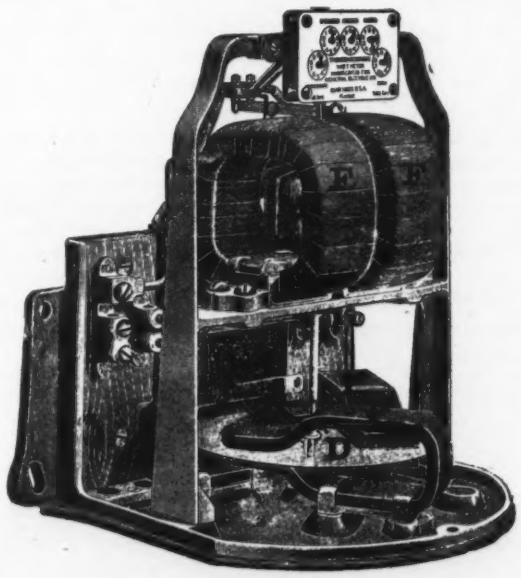


FIG. 219.—WATTMETER.

Fig. 219 represents a well-known type of meter, in which the current to be measured passes through the stationary element of the field coils F, F, while the moving element or armature M is permanently magnetized by a feeble current passing through a comparatively high resistance, wound on a frame at the back of the instru-

ment and kept in circuit with the mains. The armature M receives its current through the delicate brushes b, which rest on opposite sides of a small silver commutator, c. No iron is employed in either the field or armature of the apparatus. The vertical shaft of the armature M is geared directly with a dial-recording mechanism similar to that of a gas meter. In order to apply a load torque proportioned to the speed, a disc of copper, D, is mounted horizontally upon the vertical armature axis, so as to rotate between the poles of the three permanent magnets, P, P, P, as shown. When the disc is at rest there is no retarding torque other than a small mechanical friction due to the brushes resting on the commutator and the weight of the armature in its bearings. As soon as the disc is set in motion by the rotation of the armature, eddy currents are produced in its substance, by the dynamo action of the permanent magnets upon it, and a retarding torque is set up between the disc and these magnets. At all ordinary speeds this torque is proportional to the rate of rotation, thus complying with the requirements of the motor as a meter.

372. The armature of the motor represented in Fig. 218 is only capable of acting as a coulomb meter, or ampere-hour meter, but the apparatus shown in Fig. 219, while acting as an ampere-hour meter on constant potential mains, is also capable of operating as a watt-meter, in cases where the pressure between the mains is not constant; for, all variations in the pressure will increase in direct proportion to the useful flux Φ, linked with field and armature, and so the speed of the armature will be accelerated and retarded in proportion to the pressure, as well as in proportion to the current strength.

373. No law of retarding torque, other than the torque proportional to the speed, can give a rate of revolution in the armature proportional to the current strength passing through it, when the field flux Φ is constant. If, however, the field magnets be in series with the armature, so that Φ increases with the load, it is possible for the instrument of this character to register fairly accurately, even although the load torque is not proportional to the speed. In such cases, however, the results can only be approximate, since the hysteresis in the field magnet circuit will bring about a complicated relation between load and flux.

374. Another problem which sometimes arises, is to design a motor whose speed shall be proportional to the pressure in volts at its terminals. This problem presents itself in *motor-meters* having an armature which, instead of being inserted directly in the lamp circuit, is shunted by a constant small resistance, r. A motor-meter of this type is shown in Fig. 220. Here the danger of burning out the armature by an accidental overload is not nearly so great, since the pressure at the armature terminals can never exceed that of the drop in the shunt resistance r. If i be the total current strength in amperes passing through the lamps, and e the dynamo power of the armature, or volts per revolution per second, the current strength passing through the armature will be

$$i_1 = \frac{(i-i_1)\,r - ne}{R} \text{ amperes, } = \frac{ir - ne}{R + r}$$

where R is the resistance of the motor armature, and the driving torque will be $i_1 r$ cm-dynes.

If the frictional torque f, centimetre-dynes, be assumed constant, the speed of the motor will be determined by the relation $i_1 \tau = f$ or

$$\tau \frac{(ir - ne)}{(R+r)} = f,$$

$$\text{from which } n = \frac{ir}{e} - f\frac{(R+r)}{e\tau} \text{ revolutions per second.}$$

From this it will be seen that the motor will develop a speed pro-

Lamps.	Current thro' lamps, amperes i.	Current thro' armature, amperes i_1.	Current in shunt, amperes $(i-i_1)$.	Drop in shunt, volts.	Drop in armature, volts.	C.E.M.F. of armature, volts.	Speed, revs. per sec., n.	Revs. per lamp per second.
1	0.5	0.05	0.45	0.045	0.005	0.040	06.6	0.66
2	1.0	0.05	0.95	0 095	0.005	0.090	1.5	0.75
4	2.0	0.05	1.95	0.195	0.005	0.190	3.16	0.79
6	3.0	0.05	2 95	0.295	0.005	0.290	4.83	0.805
8	4 0	0 05	3.95	0.395	0.005	0.390	6.5	0 813
10	5.0	0.05	4.95	0.495	0.005	0.490	8.16	0.816
20	10.0	0.05	9.95	0.995	0.005	0.990	16.5	0.825

portional to the main current i, if the frictional torque f be constant, and sufficiently small to make $\frac{f(R+r)}{e\tau}$ small compared with $\frac{ir}{e}$. The following case will illustrate this result. Let $R = 0.1$ ohm, $r = 0.1$ ohm, $f = 50$ cm-gms, $\tau = 1{,}000$ cm-gms per ampere, $e =$ 0.06 volt per rev. per second. Then $n = 1.667i - 0.1667$. The preceding table shows the results which follow for various currents up to 10 amperes, either directly from the formula or by independent reasoning.

Such a motor will usually operate at a comparatively high speed at full load, since it depends upon the influence of its C. E. M. F. in reducing the current strength through the armature to that required in order just to balance the resisting torque f.

(To be continued.)

Laboratory of Houston and Kennelly, Philadelphia, Pa.

The Standard Telephone Company.

To the Editor of the Electrical World:

Sir:—In the *United States Investor*, under date of May 18, there is an article on the Harrison Telephone Company in which the following passage occurs:

"It may not be generally known (but it is confidently asserted by those who are in close touch with the workings and management of the Bell Telephone Company) that the Standard and Bell are no more and no less than one and the same. In territory where the Bell cannot operate successfully, the Standard will be the alternative."

There has been a good deal of curiosity here regarding the Standard Telephone Company, of which Thurlow Weed Barnes is president, and certain representations have been made which the electrical people here would like to be assured of, and as one of the readers of your valuable journal I write you, to learn, if possible, the standing of the company. Can you inform me whether or not they own a telephone and whether or not they have built or are building any plant whatever? They claim here that they are manufacturing telephones in Cleveland; also claim to own a multiple switchboard; also that they are now building long-distance lines from Washington to New York via Baltimore and Philadelphia and putting lines underground in Newark. We should like to be thoroughly posted, if possible, about the points above; and for the benefit of your readers, should like your opinion about this company, their intentions and their operations. The *United States Investor* is, of course, a very reputable journal, and making the assertion which it does, has naturally attracted some attention, and if such a journal would take upon itself to make this statement or at least to publish it, we think that you could benefit your subscribers and readers by your views on the matter. Telephone.

Portland, Oregon.

[The above letter, which is one of many others of like nature received during the last several months, was submitted to Mr. Thurlow Weed Barnes, the president of the Standard Telephone Company, and the use of our columns offered for any statement he might desire to make concerning the apparatus to be employed by the Standard Company, and the plants now in course of construction. Mr. Barnes pronounced the charges in the letter too utterly absurd to be considered, and declined to make any statement at the present time regarding the apparatus adopted by his company, or to make public any of its business arrangements. We can merely say, in answer to our correspondent's queries, that the names of many men of character and public prominence are connected with the Standard Company, but we are not aware at the present time of any measures on its part to enter into active construction work, though the Philadelphia papers report that last week it secured control in that city of a valuable telephone franchise. It has been rumored that the company has purchased various patents well known in telephone circles, and that it may join in the defense of a Boston infringement suit instituted by the Bell Company, but no confirmation whatever of these reports can be obtained.—Ed.]

National Electric Light Association.

A meeting of the executive committee of the National Electric Light Association was held at the Murray Hill Hotel, Tuesday evenning, Sept. 10, with the following members present: C. H. Wilmerding, president; E. F. Peck, vice-president; C. O. Baker, Jr., master of transportation; Charles R. Huntley, E. H. Davis, A. Markle, W. R. Gardener, G. A. Redman, J. J. Burleigh and John A. Seely. A committee, composed of Messrs. Seely, Peck and A. J. DeCamp, was appointed to consider the matter of holding an electrical exhibition in connection with the nineteenth convention of the Association, to be held in May, 1896, in New York. This committee was clothed with full power to act, and will report as soon as possible to the full board.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

BY CARL HERING

COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

DYNAMOS, MOTORS AND TRANSFORMERS.

Compounding Dynamos for Armature Reaction.—The Lond. "Elec. Rev.," Aug. 30, contains a brief article by Mr. Sayers which is in the nature of a note, on Prof. E. Thomson's recent Institute paper which was read at the Niagara Falls meeting. He states that it is curious to notice that with two wound and two unwound poles, and the brushes set in the forward position, as shown in the diagrams of Thomson's paper, the armature is capable of generating part of the effective flux; but this can be the case only up to a certain point, and the breaking down which occurs when the load has reached 200 amperes, he believes is not due to the cause given by Thomson, but to the M. M. F. of the armature overpowering that of the wound poles; he shows that if the excitation of the wound poles were dispensed with, the effective flux would vanish and the machine become inoperative just like a series machine with the magnets connected the wrong way. When the brushes are set backward the tendency to excite, as a series machine, is due to the effect of the armature coils included in twice the angle of negative lead and the effect is in no way dependent on the construction which is the subject of the paper. He fails to see any connection between the self-exciting machine devised by himself, which has no winding on the magnets, and that described by Thomson; he believes they are wholly independent of each other. He considers Thomson's paper to be of great interest and thinks the diagrams of potentials around the commutator to be specially instructive.

Armatures and Magnetic Coils.—The article by Mr. Hill (see Digest last week) is concluded in the Lond. "Elec. Rev.," Aug. 30; he gives a number of formulas and hints regarding the practical calculation of magnetic coils and also a description of a modified slide rule for facilitating such calculations; the results do not admit of being abstracted.

Calculation of Dynamos.—"L'Ind. Elec.," Aug. 25, contains an article by Mr. Girault in which he gives a number of comparatively simple practical formulas relating to continuous-current armatures; they are worked out for a Gramme bipolar armature and are then modified for the other forms; the results do not admit of being abstracted; a numerical example is given.

LIGHTS AND LIGHTING.

Luminescent Light.—An Academy paper by Mr. Witz giving some measurements regarding the energy in luminescent light is published in "L'Eclairage Elec.," Aug. 24, and "L'Elec.," Aug. 31. It is generally thought that the solution of the problem of generating light will be reached by using luminescent light such as in Geissler tubes, in which the temperature is between 21 and 132° C., according to Warburg, showing that there is little heat radiation; he therefore measured the energy required by such a tube, used a miner's lamp and another intended for use in medicine and surgery; the miner's lamp was illuminated by a small Ruhmkorff coil giving a 20-mm spark and furnished sufficient light to enable one to read tables of logarithms at a distance of 16 inches from the source; the nature of the light makes it difficult to measure it by means of the usual photometer; the voltage was 4,190 and the current 0.27 milliamperes which is equivalent to 1.13 watts; the energy consumed is therefore great, relatively to the light. He then used a Holtz machine, measuring the power required to run it by means of a Hirn dynamometer at 726 revolutions per minute (the size of the discs is not given); the results were as follows, in kilogramme meters per second: no load 1.043, when short circuited 1.785, when producing eight sparks per second 145 mm long, 2.174, when running the miner's lamp 1.711, when running the surgical lamp 1.763; subtracting the first from the fourth gives 0.668 kg or 6.6 watts as the powers used in the miner's lamp, showing a still poorer efficiency than the first figure; an incandescent lamp requires three watts per candle, while this lamp takes more energy and gives much less light and he therefore characterizes it as a "ruinous method of lighting." The surgical lamp was placed in a calorimeter and was found to give 0.00033 calories per second which corresponds to 0.140 kg; the illumination of this tube required 0.720 kg while the heat produced is only about one fifth of this energy, which is a result much better than that produced in any other form of light. His experiments therefore show that in luminescent lighting the proportion of the heat energy to the total energy is less than in any other light; by reducing the loss to a minimum, concentrating the light in a small space, using fluorescent substances, and devising special arrangements, he thinks we can hope to realize lights the efficiencies of which will be better than that of our best sources of light. In an editorial note following the paper the author is asked to explain what becomes of the differences between the 0.720 kg. per second delivered to the tube, and the 0.140 kg. per second absorbed by the calorimeter; there seems to be a disappearance of thermic power and it is hard to believe this without further proof.

Heating Properties of Sources of Light.—The Lond. "Elec.," Aug. 30, quotes from the Lond. "Engineer" some figures given by Prof. Palaz, which show the advantages of electric lighting from the standpoint of coolness. For a given quantity of light the relative figures are as follows: arc light, 4; incandescent light, 14; kerosene, argand burner, 331; gas, argand burner, 380; candle, 473; gas, butterfly burner, 511.

Train Lighting.—According to the Lond. "Elec. Eng.," Aug. 30, it is stated that electric lighting for railway carriages has now been adopted for all the express and mail trains on the leading railways in Russia.

POWER AND HEAT.

Ten-Thousand Volt Alternating-Current Plant.—"L'Ind. Elec.," Aug. 25, publishes an illustrated description by Mr. Biles of the first 10,000-volt installation in France on the River Ardieres in which a water power of 200 hp is transmitted to various distances up to 14.4 miles. The alternator generated 5,500 volts directly, at which voltage part of the energy is transmitted to a town several miles distant, while for the more distant places the current is transformed up to 10,500 volts; the line is run overhead on wooden poles and some difficulty was experienced with its insulation; at first oil insulators were used, but were not sufficient, as a number of the insulators were cracked by the current; every pole is provided with lightning arresters, which have proved satisfactory, but it is stated that in another installation of the same kind it would be still better to use a continuous lightning arrester as in the installation on the Kiel Canal; by way of precaution two entirely independent circuits were erected on the same poles, partly to provide against accident and partly because it will then be possible to keep the motor currents and the lighting currents separate.

Heating and Welding.—A description of the Zerener process is published in "L'Ind. Elec.," Aug. 25, including good illustrations showing the external appearance of the apparatus, an outline illustration of which together with a description was published in the Digest, Aug. 3; in this method an electric arc between two carbons is used in connection with a magnet which blows the arc out into a point making it resemble a blowpipe flame. The article contains but little more than has already been given in a previous description; 40 volts and 15 amperes is sufficient for small work, while for brazing like in bicycle frames, 40 to 60 amperes are required; the apparatus weighs 2.2 pounds.

TRACTION.

Accumulator Traction.—The Lond. "Elec.," Aug 30, gives the following results for the past year of the accumulator cars at Birmingham. With a practically stationary mileage the receipts decrease about 6 per cent. and the expenses increase about 27 per cent.; the total cost of a car mile increased from $14.75 to nearly $18.50, the difference being due quite as much to increased wages as to increased cost of material; several types of cells have been used.

Some further data is given in "El'ty" (N. Y.), Sept. 11. The Birmingham company uses four systems, horse, steam, cable and electric; the steam and cable lines are very profitable and the other two are continued sources of anxiety and difficulty; the accumulator line has resulted in a loss during the past year of nearly $9,000, the blame being laid on the batteries; the cost of working per mile by the different systems is given as follows; steam 18.22 cts., horse 17.34, cable 10.86, electric 36.86.

Electric Car Tests.—Mr. H. S. Hering's article (see Digest last week) is continued in the "Elec. Ry. Gaz.," Sept. 7; he gives typical records of traction dynamometer measurements in drawing cars over uniform and varying grades and explains the calculation of the traction coefficient and the mechanical horse-power; he gives a large table containing complete data of a number of tests made with various cars, among which are the track data, time, speed, traction, weights and horse-power; in this table the traction coefficient in pull per 1,000 lbs. are averaged for each test and vary between 4.30 as a minimum and 6.37 as a maximum; the average value for the trailer was 4.67 lbs. on a dry track and for the motor car on a dry track 6.37 lbs.; for a wet track the average was 4.97 (presumably for the motor car) and when the gears were removed it was 4.67 (presumably for a dry track).

Hoerde Conduit System.—The "Elec. Rev.," Sept. 11, reprints some of the illustrations with a brief description, from the article mentioned in the Digest last week.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Installations.—An interview with Mr. Kolben, of the Oerlikon Works, is published in the Lond. "Elec. Eng.," Aug. 30. Regarding the usual system of town lighting in Switzerland, he states that in all towns where electricity is used chiefly for lighting, his company uses single-phase alternating currents; motors up to 10 or 12 hp are used on such systems; in no case is the continuous current used now in large towns, as the cost of the mains is prohibitive; in some small villages, where the lighting is very compact and close to the station, the continuous current is still used. They standardize their alternators and transformers at one, two, three and five thousand volts, all of which are generated directly by the alternator, but for voltages above 5,000 they transform up from the alternator; their factory is driven from a water power installation 16 miles distant, using 13,000 volts and transformers at each end. The Swiss and German practice regarding cables is to use lead-covered paper cables exclusively, usually laid in stoneware conduits or troughs and in a few cases in cast-iron ducts; in some places the ducts are replaced by iron armoring. In Zurich the charge is 14 cents per kw-hour, at which price the station earns a large annual profit. He uses a three-phase alternating system for large transmissions if the main demand is for power, because with this system the cost of the line is a minimum; if lighting is to be done from the same station they sometimes use the star winding, connecting the junction points by means of a neutral wire which greatly reduces the fluctuations of voltage when the branches are unequally loaded. The standard method which he devised for starting their motors is to use transformers in connection with the switch, instead of using the full voltage at starting; the current required is then always less than the normal working current of the motor and with moderate sized motors is even less than half; they also equip their motors with a fast and loose pulley; the starting device and switches are illustrated and described. He considers the installation at La Goule (see Digest, Aug. 31), as one of the most interesting power and light stations; 1,500 hp is distributed by means of the single-phase system to a number of towns up to 16 miles distant. A great obstacle to the use of alternating-current motors in England is the great variations in frequencies; the standard frequency of his company is 50; 133 he calls abnormal. A brief description is also given of the large 8,000-ampere machines which are being built for the Aluminium Company, of Scotland; five of these are to be used, each having an output of 8,000 amperes and 65 volts at a speed of 150; the armature is drum-wound and the machine has 24 poles and 120 brushes; the diameter of the armatures is 7 ft. 3 in. and the circumference speed is therefore 3,420 ft. per minute. The ring method for oiling has been universally adopted by his firm.

WIRES, WIRING AND CONDUIT.

Self-Induction of Armored Mains.—The Lond. "Elec.," Aug. 30, contains an article by Mr. Witcher in which he discusses mathematically the self-induction in single conductors or in those in which the two currents do not balance; the object is to show to what extent it is safe to ignore the inductive effects of the iron; he assumes that the currents follow the sine law; he does not investigate an important effect, namely, the extra copper due to the increased wattless current caused by the self-induction in the iron armoring. The results of his calculations are given in a practical form in tables which give the drop in volts per 100 feet for cast and wrought-iron pipes, and steel-armored cables, for different sizes and thicknesses of the iron.

ELECTRO-PHYSICS AND MAGNETISM.

Electrical Properties of Selenium.—The recent paper by Mr. Bidwell abstracted in the Digest, July 27, is published in full in the "Phil. Mag." for September. The conclusions which he arrives at from a large number of experiments are as follows: "1. The conductivity of crystalline Se appears to depend principally upon the impurities which it contains in the form of metallic selenides. It is suggested that the selenides conduct electrolytically, and that the influence of light in increasing the conductivity is to be attributed to its property of facilitating the combination of selenium with metals in contact with it. 2. The specific resistance of crystalline Se has no definite value but is always very high, varying in the specimens tested from about 30 to 1,600 megohms. It is not in general diminished by prolonged heating unless the Se is in contact with a metal. 3. A Se cell having Pt electrodes and made with Se to which about 3 per cent. of cuprous selenide has been added is, even though unannealed, greatly superior both in conductivity and sensitiveness to a similar cell made with ordinary Se and annealed for several hours. It is not, however, quite equal to a cell prepared in the usual way with copper electrodes. 4. A particular sample of commercial Se which, when treated in the ordinary manner, was almost absolutely insensitive to light, was rendered sensitive by the addition of a little metallic selenide. 5. The great fall of resistance exhibited by pieces of Se with fused-in electrodes after the lapse of a few years, is not due to any material lowering of the specific resistance of the Se, but to short-circuiting by selenide formed at the expense of the electrodes. The resistance of an old cell was instantly raised from 10 ohms to 60,000 by connecting it with a 52 volt battery and thus burning out the short circuit. 6. Red Se in contact with copper or brass is quickly darkened by the action of light, owing, it is suggested, to the formation of selenide. Photographs may be printed on copper or brass-coated with red Se and preserved in darkness for a long time. 7. The resistance of crystalline Se always decreases with rise of temperature. The apparent increase of resistance on heating generally observed when the electrodes are fused into the substance, is to be explained by the fact that the heat-expansion of the Se is much greater than that of the metallic electrodes; imperfect contact is consequently produced at the junction. 8. Crystalline selenium is porous and absorbs moisture from the air. 9. The polarization of Se after being traversed by a current is due to absorbed moisture. 10. The moisture ordinarily present in Se renders the apparent resistance much lower than the true resistance of the substance. 11. The presence of moisture is not essential to sensitiveness, but appears to be in a slight degree favorable to it. 12. When a current is passed through cuprous selenide between platinum electrodes which are covered with moistened paper, red Se is deposited on the anode paper and metallic copper on the cathode paper. 13. If cuprous selenide is made the cathode and a strip of Pt the anode in the water, red Se mixed with detached particles of the selenide is deposited in the water. 14. With a mixture of cuprous selenide and Se the quantity of detached black particles is greatly diminished, but the weight of the separated red Se appears to be greater than that required by the law of electrolytic decomposition. Possibly the current has the effect of converting pure crystalline Se when moistened into the red amorphous variety. 15. The hydrogen produced by the action of zinc upon dilute sulphuric acid has no effect upon the cuprous selenide nor upon Se in contact with the zinc. 16. The photo-electric currents sometimes set up when light falls upon Se are dependent upon the presence of moisture and are no doubt of voltaic or chemical origin. 17. Experiments which have seemed to place well-annealed selenium above platinum in the thermo-electric series were vitiated by the presence of moisture. Dry Se is always below Pt."

A New Way of Using the Thermopile.—In the "Electrochem. Zeit." for September Mr. Meyer describes a modified method which he uses apparently with good results. He alternately heats and cools each one of the two junctions; this intermittent heating and cooling is produced by movable dampers; by this means direct, alternating or multiphase currents can be generated; the object of the intermittent heating is to overcome certain objections to the usual method; when one of the junctions is heated and the other cooled continuously the difference of temperature can never have its full effect; as there is a constant heat current from the hot to the cold junction, the heat which it is desired to convert into electricity is mostly used to raise the temperature of the cooled junction and is therefore largely lost; he admits that intermittent heating can never produce such a favorable heating effect as a constant heating, but this is limited; if metals are chosen which are good heat conductors and have a low specific heat and if the junctions are such that they will readily take up heat and radiate it equally well, they will readily follow temperature variations with small losses of heat and the whole action will be concentrated at the junction, which favorably affects the efficiency; a higher degree of heat can then be used, as the heat is not applied continuously to one junction. With a somewhat primitive form of apparatus he obtained an absolute efficiency of 62 per cent. which is a very good result as compared with that in the ordinary thermopiles.

Conductivity of Mixtures of Metallic Filings and Dielectrics.—The Lond. "Elec.," Aug. 30, quotes from "Comptes Rendus," Aug. 19, from a paper by Mr. Lhuillier giving the results of some experiments made with mixtures of copper, aluminum or iron filings and liquid and solid dielectric substances. His experiments show that "the displacement of filings in a liquid dielectric or *vice versa* can be carried out without destroying the conductivity of the mixture and also without producing it." The filings may be displaced in alcohol by means of a magnet but the conductivity does not disappear, it being only slightly modified; gentle tapping, however, completely annihilates the conductivity; alcohol may be replaced by an equal volume of fresh alcohol without modifying the conductivity; a liquid dielectric may be replaced by any other having no chemical action on it without affecting the resistance of the mixture, but if the second dissolves the first, the resistance may rise very greatly in a short time. He concludes that if the dielectric plays an active part it is only through a very small distance; he believes that it does not become conducting for short distances.

Experimental Study of the Disruptive Spark.—An article on this subject by Mr. Broca is begun in "L'Eclairage Elec.," Aug. 24; he discusses the different kinds of sparks, their properties and the laws governing them. Among other things he shows the following: "That the condition which is necessary and sufficient for producing rapid oscillations, is that the spark is disruptive"; "a spark is at the centre of excitation from which the rapid oscillations which are produced by the rupture of the dielectric, start."

Resistance of Bismuth.—The "Phil. Mag." for September contains a paper by Profs. Dewar and Fleming on "Variation in the Electrical Resistance of Bismuth when Cooled at the Temperature of Solid Air." The results of very carefully made tests show that there is a very marked difference between different samples of bismuth when subjected to very low temperatures and that its behavior at these temperatures in magnetic fields is also abnormal; further tests are to be made with electrolytic

bismuth, after which they expect to be able to distinguish between the effects which are due to the physical condition and those due to impurities.

Magnetic Potential.—The article by Dr. Bedell, mentioned in the Digest, Feb. 2, is reprinted in the "Elec. Rev.," Sept. 11.

Unipolar Induction.—A translation of the article by Dr. Weber, which was abstracted in the Digest last week, is published in "El'ty," Sept. 11.

Action of Electric Currents on Aluminum Wires.—A translation of the complete article, which was abstracted in the Digest, Sept. 7, is published in the "Elec. Rev.," Sept. 11.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrolysis of Gases.—A Royal Society paper by Prof. J. J. Thomson is reprinted, apparently in full, in the Lond. "Elec.," Aug. 30; he describes interesting experiments in which the spectroscope was used to detect the decomposition of gases by the electric discharge and the movement of the ions in opposite directions along the tube; the presence or absence of certain ions at the positive and negative electrodes were ascertained by means of their spectra. He shows among other things that different ions may become either positively or negatively electrified; from a chemical side the results are of interest as showing a method of investigating the elementary condition of the gas.

Electrolysis of Chloride of Calcium Solutions.—The "Zeit. f. Electrochem.," Aug. 20, contains the first part of an article by Dr. Schoop in which he discusses the Hermite process of producing bleaching liquids, points out objections to it and shows the advantages of using solutions of chloride of potassium, which may be electrolyzed without difficulty and with greater reliability; he describes researches in which solutions of chloride of calcium were used, a material which is a bi-product in ammonia and soda factories and is therefore more easily obtained than chloride of magnesium. He finds that three volts will suffice for the electrolysis, a fact which is very important, as the cost of the power is the chief expense; the output depends on the density at the anode and is larger the smaller this density is; circulation is necessary; he describes an apparatus in which the liquid flowed between two parallel electrodes which formed the sides of the trough; the article is to be continued.

Depolarization by Means of Air.—In a note by Mr. Steinach in the "Elektrochem. Zeit." for September he mentions the suggestion of Mr. Simon to depolarize carbon plates by making them hollow and forcing air into them, which air in passing through them will act as a depolarizer. Steinach made a large number of tests all of which were failures, and he finds that if the air is to escape equally over the surface in small quantities, it will require a carbon with exceedingly fine pores, and such a one he has not found it possible to make; with the best results he finds that the quantity of air required is far too great to enable the method to be used in practice.

Pure Zinc.—An article by Messrs. Mylius and Fromm is abstracted at some length in the "Zeit. f. Electrochem.," Aug. 20; they show among other things that the electrolytic processes for refining zinc are not practicable.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Localization of Earth Faults on Electric Light Circuits.—In a short article by Mr. Pigg in the Lond. "Elec.," Aug. 30, he describes a simple and practical method for locating faults while the circuits are in use. If the two station ends of the lines are connected by a resistance, the middle point of which is connected to earth through a galvanometer, the latter will not be affected if the insulation remains perfect, but if a fault exists there will be a deflection, the direction and intensity of which will indicate the fault; if the point of deflection with the galvanometer be moved a point will be found where there is no deflection; the location of the fault may then be determined by the relative resistances along the artificial resistance wire. For this case he develops the following formula: the resistance between the station and the fault is equal to the resistance on the resistance wire between the galvanometer connection and the faulty main multiplied by the station voltage and divided by the resistance of the artificial circuit (that is, the resistance wire), multiplied by the current in the lighting circuit at the time of the test. (The letters used in the formula and those on the diagram do not agree, but the above interpretation appears to be what is meant, but its correctness is not vouched for by the compiler.) The artificial resistance may be so proportioned that the result may be read off in distances to the fault. If the system is an incandescent lighting system, the resistance of the circuit may be considered as made up of two parts in series, one, the mains, having a constant resistance, and the other, the distributing cables and lamps, having a resistance which varies with the number of lamps; by making the artificial circuit similar, the location of the faults is simplified and becomes a simple matter of inspection; in this case the ends of the artificial resistance are two fixed slide-wire resistances, while the middle is made up of a resistance which can be varied in proportion to the number of lamps; an example is given. A fault between the dynamo and the artificial resistance will give a deflection of the galvanometer, but it will be found impossible to obtain a balance; a fault in the shunt magnet winding may be distinguished from one on the mains by varying the current slightly in the shunt circuit keeping that in the lamp circuit constant, if the point of balance is altered thereby the fault is in the shunt winding; a fault in the armature can easily be detected by the unsteady deflection in the galvanometer due to the alternating currents; a faulty main may be distinguished from others worked from the same bus bars, by varying the currents in them in turn until one is found which requires a fresh adjustment on the slide wires to preserve the balance.

The Measurement of Varying Currents in Inductive Circuits.—In an article by Messrs. Porter and Morris published in the "Phil. Mag." for September they describe an application of the principle of the potentiometer and the measurements of rapidly varying but not alternating voltages, and hence currents. A non-inductive resistance is connected in series with the inductive coil the current in which is to be measured, by means of the voltage at the ends of the non-inductive resistance; the connections are made from the ends of this non-inductive resistance with a potentiometer wire by the ordinary method, but the galvanometer is in this case provided with stops so that the needle can turn in one direction only; "let now the strength of the current rise continuously, the slider meanwhile making contact with the potentiometer wire at such a point that a balance occurs for a particular value of the current. There will then be a current in the galvanometer which changes sign at the instant of potentiometer balance; and if the galvanometer terminals are so connected that the initial current in it forces the needle against the stops, the needle will begin to fly off just as this current passes through zero. Therefore if the galvanometer circuit be broken at or before this instant no throw of the needle is produced; it is clear then that either by altering the time interval during which the current is permitted to flow through the galvanometer, or by adjusting the position of the slider, the throw can be reduced to zero"; the fall of potential on the potentiometer wire would then be equal to the fall along the non-inductive resistance if it were not for the self-inductance of the galvanometer. The conditions are discussed mathematically and the formulas are given. The chief difficulty lies in the use of a stopped galvanometer; the one used is described and illustrated; the best material which they found for the stops was soapstone. Although the method described was applied to the voltage at a non-induction resistance, it is equally applicable in the measurement of the difference of potential between the ends of an inductive resistance.

Test of Continuous-Current Motors.—A description, showing the application of Kapp's method, of a test made of two continuous-current motors, is published in the Lond. "Elec. Eng.," Aug. 30; the two machines are belted together and connected electrically with a small generator in circuit to supply the lost voltage.

Measurement of Cyclically Varying Temperatures.—The paper by Mr. Burstall, which was recently abstracted in the Digest, is published in full with two large plates in the "Phil. Mag." for September; he describes a method of measuring the temperatures in the cylinder of a gas engine by means of a small wire whose resistance is measured and which can be introduced into the cylinder.

Ten-candle Standard Pentane Lamp.—A well-illustrated description including details, of this lamp which was recommended by the English Photometric Standards Committee, is published in the "Zeit. f. Beleucht.," Aug. 31; it is known under the name of the Dibdins lamp; it appears to be taken from the "Jour. of Gas Lighting," May 14, 1895. A reference is also given to a detailed report by the Reichsanstalt on the Hefner amyl acetate lamp, which appeared in the "Zeit. fuer Instrumentenkunde," No. 5, 1895.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Rewinding Rapid Telegraph Apparatus.—An article by Mr. Montillot is begun in "L'Elec.," Aug. 31, in which he gives descriptions of various automatic devices for rewinding telegraphic apparatus for rapid transmission; an illustration of the pedal motor for the Hughes apparatus is given.

MISCELLANEOUS.

Artificial Substitutes for India Rubber.—Mr. Rice in the "Ind. Rub. World," Sept. 10, states that a chemical product which is in some degree a substitute for pure india rubber, has been discovered in England and has been developed there and in this country for the past year or two; no information is given regarding its composition and it appears to be mainly a substitute for hard rubber; it will be put on the market after it is thoroughly developed; nothing is stated about its insulating qualities except that "it has a field for use as insulating material."

New Books.

PROCEEDINGS OF THE ELECTRICAL SOCIETY OF CORNELL UNIVERSITY, 1894-95. Vol. 11. Ithaca: Andrus & Church. 122 pages, 47 illustrations. Prices, 75 cents.

This society is made up of students and professors from the university Both are active in presenting papers at its meetings. The present volume contains the papers presented during the academic year 1894-95. The following is a list of titles and authors:

Difference of Electrical Potential between Substances in Contact, by C. D. Child.—Metals for Magnet Cores, by C. E. Barry.—Fuse Wire, by C. P. Matthews.—Lightning Arresters, by C. E. Hewitt.—Mechanical

Equipment of Power Stations, by Prof. R. C. Carpenter.—Some Points in Connection with the Modern Theory of Primary Batteries, by Prof. Ernest Merritt.—A Method of Reducing Hysteresis Losses in Armature and C^2R Losses in the Field, by R. B. Mann.—Electricity and Mining, by C. R. Sanderson.—Electrical Resonance and Some Allied Phenomena, by Dr. Frederick Bedell.—Alternating Current Motors, by Prof. Harris J. Ryan.—Metallic Conduction and the Influences which Affect It, by F. J. Rogers.

In the majority of cases the subject matter is not new, the papers consisting rather of a thorough compilation of materials gathered from books and the periodical literature.

Domestic Electrical Work. Concise and practical explanations for plumbers, tinners and hardware dealers, on how to wire buildings for bells, alarms, annunciators, and for gas lighting from batteries. By William A. Wittbecker. New York: David Williams. 55 pages, 22 illustrations. Price, 50 cents.

This book, as detailed at length in the sub-title, consists of explanations and directions for plumbers and hardware dealers on how to wire buildings for bells, alarms, annunciators and gas lighters.

Accumulator Traction.

BY MAURICE BARNETT.

Now that storage battery cars are to be introduced in New York on the Fourth Avenue Railway, on the understanding that if storage battery traction proves more practicable and economical than other representative traction systems the cars on the Fourth and Second Avenues lines will be equipped with storage batteries, it is a matter of considerable interest to railway and electrical men to know how far the hopes of friends of the storage battery are liable to be realized, and what showing battery traction will make against its competitors, (1) the trolley system, and (2) the underground conduit system. In this connection it might be said that although the underground conduit system has obtained a foothold here sooner than the storage battery system, it is very doubtful whether the former will come into general adoption. The closest estimates on total investment, including real estate, road and complete equipment—estimates based on a study of the systems in New York and Washington—fix the cost of the underground system at about $100,000 per mile of track length, or between three and four times that of the accumulator system. Moreover, the total operating expense of the underground system, including interest on investment, is about 19 cents per car-mile against 15 cents for the trolley. This large difference is accounted for by the excessive interest charge which the former system must pay. The necessity for some system other than animal traction and trolley traction has, of course, led to the adoption of the underground conduit, but it is almost certain that just as soon as it shall have been demonstrated that storage battery cars can successfully compete, under certain conditions, with the trolley system, underground conduit systems will play an insignificant part in the development of electric traction systems in the United States.

The Electric Storage Battery Company, of Philadelphia, which is putting in the new cars in New York, appears to be exceedingly sanguine as to the results which will be obtained with the new cars which, in many respects, embody radical points of departure from previous types of storage battery cars. The Storage Battery Company claims to base its estimates as to the capability of its cells upon actual knowledge of the daily performance of the "Chloride" accumulator in traction work in France, where a type of battery similar to that to be employed in New York has given entirely satisfactory results.

There has never been any doubt as to the advantages possessed by a storage battery system of electric traction, the only doubt ever expressed being one concerned solely with the question of operating expenses. The great drawback has been, not the weight of the battery, as many persons think, but the cost involved in the maintenance and handling of the cells in traction work. In the old-style accumulator cars the battery was placed in the sides of the cars under the seats. The expense of inserting and removing this each trip added considerable to the operating expenses. In the new cars the battery will be placed under the car where it can be handled easily and at about one quarter the former cost of this operation. A report by Mr. J. Sarcia, which can be found in the *Bulletin de la Société International des Electriciens*, leads to the hope that the cost of maintaining and handling batteries in traction service will be, in the style of car suggested, something under three cents per car mile. The manufacturers hope to be able to show, ere long, that this amount can be made up by saving in interest, a diminished expense for maintaining motor equipment and a smaller cost for the motive power.

The favorable features of a storage battery system of traction are well known, one of the strongest being the fact that each car is a unit by itself, independent of the power house during its trips and in no way embarrassed by derangement in the station or overhead equipment. Again, as the load on the engines and dynamos in a storage battery system is constant it follows that these need not have greater capacity than is sufficient to satisfy the *average* demand for power. Mr. O. T. Crosby puts the relative generating plant capacity required by the trolley and accumulator systems as 3 to 2, respectively. In considering later on the relative cost of construction under the two systems, this ratio will be assured. (This, incidentally, emphasizes the value of an auxiliary storage battery plant for roads already equipped with the trolley system, the storage battery serving as a reservoir to store up the energy representing the difference between the average and the maximum demand on a generating plant, and as a regulator, enabling the engines and dynamos to be worked at a constant load and securing them from the strains and stresses to which they would otherwise be subject.)

Furthermore, in the storage battery system there is no loss of pressure in conductors; the grounding of one motor does not affect others; the durability of the motors is greatly increased by reason of the low pressure practicable in this system; and lastly, there is not the overhead trolley line with the attendant danger to life and property growing out of the high-tension current and obstructive wires employed in the direct system. In the event of a positive demonstration that storage battery cars are capable of efficient service at the same or even slightly greater expense than trolley cars, attention will again be directed to the advantages of the storage battery system, when a tendency may be manifested to limit the construction of overhead lines and to multiply the number of storage battery cars—the first system of electric traction ever tried here or abroad, and neglected only because the difficulties in the way of its adoption were not worked out so quickly as in the case of its competitor, the trolley system.

In considering the approximate cost of traction by storage battery cars the point of chief interest is the factor of maintenance and handling. This, according to the report of Mr. J. Sarcia already referred to, was 3⅓ cents per car mile—a figure, however, susceptible of marked reduction. In order to explain this and at the same time to show that the above figure was based upon conditions not wholly favorable to storage battery traction, it may be interesting to give a synopsis of Mr. Sarcia's report, descriptive of the industrial application of accumulators to electric traction made by the Tramway of Paris and the Department of the Seine on the lines from St. Denis to Paris and from St. Denis to Neuilly.

The lines in question, which are known as (1) Saint Denis-Madeline, (2) Saint Denis-Opera, and (3) Saint Denis-Neuilly, have their termini near the depot of Saint Denis. On these lines electric traction superseded horse traction June 1, 1892, and up to the present time about 2,000,000 car-miles have been covered by the storage battery cars. The grades are fairly severe, being as high as 4 per cent. for considerable distances and ranging frequently from 2 to 2½ per cent. On the Madeline line each car covers daily from 88.8 to 97.5 miles. The conditions on the Opera line differ in that the motor car tows an ordinary car carrying 50 persons, making 100 persons in all hauled by each motor car. On the Neuilly line each car makes two trips out and back on the Opera and Madeline lines, or about 30 miles on a single charge of the battery. On good Vignole rails, where the traction coefficient was only 13.2 pounds to the ton, the distance covered on each charge of battery was no less than 70 miles. Mr. Sarcia further points out that in order to replace a discharged battery by a fresh one it was necessary to handle 24 trucks, involving a large expenditure of labor. The necessity for this grew out of the circumstance that the company, instead of building a modern power-house with every convenience for reducing the handling of the batteries, rehabilitated the old horse-car stable and converted it into a charging room. Moreover, instead of supporting the battery under the car, it was placed in the sides of cars underneath the seats. Mr. Sarcia estimates that in the style of car to be used in New York a saving of ⅛ cent per car-mile could be effected in handling. Subtracting this from 3⅓ cents given as a result actually obtained in practice, we have 2.7 cents as cost per car-mile for maintenance and handling of battery.

The cost of power will obviously depend on price of coal at power house, cost of labor, oil, waste, water and other supplies. Mr. T. S. Badger gives the average cost of power as 1.96 cents per car-mile, for 22 trolley roads with from three to 140 cars in operation; length of track, three to 51 miles; daily mileage, 80 to 150; average daily mileage, 110. Now, as in the storage battery system, engines and dynamos are run at a constant load it is safe to assume that cost of power, neglecting interest and depreciation, will not exceed 80 per cent. of the figure given, or 1.56 cents per car-mile. Authorities are not wanting who ascribe to the storage battery system an even greater efficiency. In Dubuque, Iowa, with a comparatively small number of storage battery cars in operation, the cost for power was only 1.8 cents per car-mile—bearing out the belief that 1.56 cents is not too low for well-designed power-houses operating a fair number of storage battery cars.

As already stated, owing to the low pressure used in the storage battery system, the durability of the motors is very greatly increased. The average maintenance cost of the rolling stock of the 22 trolley roads cited is 1.8 cents per car-mile. Mr. Sarcia puts this factor at one cent per car-mile. In New York, where every effort will be made to introduce the very best electrical equipment, and carry on the work under the most favorable conditions, it is safe to say that the true figure for maintenance of rolling stock will not be more than .8 cent per car-mile.

Regarding maintenance of power plant, it may be said that inasmuch as the power plant in a storage battery system need be only two thirds as large as that in a trolley system, the maintenance cost will be only two thirds as large. As a matter of fact, it will probably be only one third as large, since the machinery is free from the strains to which it is subject in the direct supply system. There being, furthermore, no

external circuits, lightning is less apt to play havoc with the electrical part of the equipment.

Coming down to the question of interest on total investment, consider first the investment per mile of track length of the trolley system. Trolley construction, where iron poles are used and where, as in cities, the feed wires must be buried, will cost about $12,000 per mile of single track. As 16 to 20-foot cars can be had fully equipped for say $3,250 each, two cars (to the mile) will cost $6,500. Making an allowance of 15 hp per car, at $100 per hp, for power plant, excluding real estate or buildings, we have for the two cars $3,000. Cost of roadbed will add about $7,500 per mile of track, while real estate, buildings, etc., may be assumed to be $7,000 per mile of track—making a total investment of $36,000 per track-mile. On the basis of 56,000 car-miles run per annum per mile of track length, we have, at 6 per cent. per annum, an interest charge of 3.85 cents per car-mile to be added to operating expenses. For storage battery construction there is an item approximating $7,600 for batteries for the two cars not found in trolley construction. On the other hand, a saving is effected of $12,000 for overhead construction, while the cost for power equipment and real estate is reduced by one third, being $2,000 for the former and $4,666 for the real estate, buildings, etc. We thus have a total cost of construction of $28,267, or say $28,000; and with the same trackage as in the case already considered, we have an interest charge, per car-mile, of 2.99 cents.

Assuming that in the two cases just considered maintenance of roadbed and track, transportation and general expenses will remain the same, we can arrange in parallel the values already given. A general distribution of expenses per car-mile is, then, as follows:

	Trolley. Cents.	Storage Battery. Cents.
Maintenance of roadbed and track	.54	.54
Maintenance of line	.18	..
Maintenance of power plant	.36	.12
Maintenance of rolling stock	1.80	.80
Maintenance and handling of batteries	..	2.70
Cost of power	1.96	1.56
Transportation expenses	4.98	4.98
General expenses	1.26	1.26
Interest on total investment	3.85	2.99
Total	14.93	14.95

As given here the cost of operating cars by the trolley and storage battery systems, respectively, on roads of 15 miles and upward, with 20 or more cars averaging about a hundred miles daily, with moderate grades—general conditions covering cost of fuel and supplies, wages, etc., being identical—shows both systems to be on an equal footing. Conditions slightly in favor of storage battery construction would, of course, show greater economy for the accumulator system. Thus, if the length of track was great in proportion to number of cars run, the extra interest on the higher relative cost of line construction would swell the operating expenses of the trolley system. Or, again, since fuel is the largest factor in the cost of power, localities where fuel is high priced would change the totals and make battery traction more economical.

In conclusion, it may be said that even if trolley traction were more economical than storage battery traction, the system would be open to the objections that the (1) cars are dependent at all times on the power-house, and have no auto-mobile character as have battery cars; (2) the moment the trolley leaves the line the cars are left in darkness; (3) the high-tension currents constitute a source of danger to the traveling public; (4) the trolley line is unsightly; and (5) overhead wires are a formidable obstruction to firemen engaged in the never pleasant work of fighting fires. Inasmuch as a successful storage battery system would be, both from the point of view of the public and the street car company, what Mr. T. L. Pope calls "an ideal solution of the problem of electrical transportation," it is evident that this system—having total first cost and operating expenses in its favor—is bound to have a speedy and wide development and play no insignificant part in the future history of electric traction in this and other countries.

New Automatic Limit Switches.

We illustrate herewith some new devices recently put on the market by The Card Electric Company, of Mansfield, O. Fig. 1 shows a new safety limit switch and rheostat for starting stationary motors, and is not only intended to be a perfect safeguard against damage to the motor from open circuits on the line while the motor is running, but is claimed to be absolutely reliable as a limit switch and may be adjusted for any degree of overload desired.

The principal operating parts consist of two bar electromagnets connected in circuit with the motor armature and provided with two armatures, a double-pole switch with spring release, a resistance-controlling contact arm held normally at "off" position by a flat coil spring and the usual contact points and blocks. The chief novelty, however, lies in the arrangement of parts constituting the magnetic circuit. The two bar electromagnets operating the releasing mechanism are provided with pivoted armatures at each end, common to both, the lower one acting as a yoke when closed, forming, with the two cores, a simple horseshoe magnet; this armature or yoke is so arranged that should the current be cut off while the motor is running, the spring provided for throwing the double-pole switch will instantly be released and trip a catch holding the rheostat arm, allowing that to be thrown to the "off" position over the contact points, cutting the resistance in and placing all parts of the apparatus in proper position for starting again. An overload pulls the upper armature down, releasing the detent holding the switch closed and that, with the swinging arm, is instantly thrown to the starting point in the same manner as above described.

The magnets of this switch have a single coil of heavy wire, of few turns, carrying the full current of the motor; there are no fine wire coils or differential winding to give trouble and cause unreliable action. The

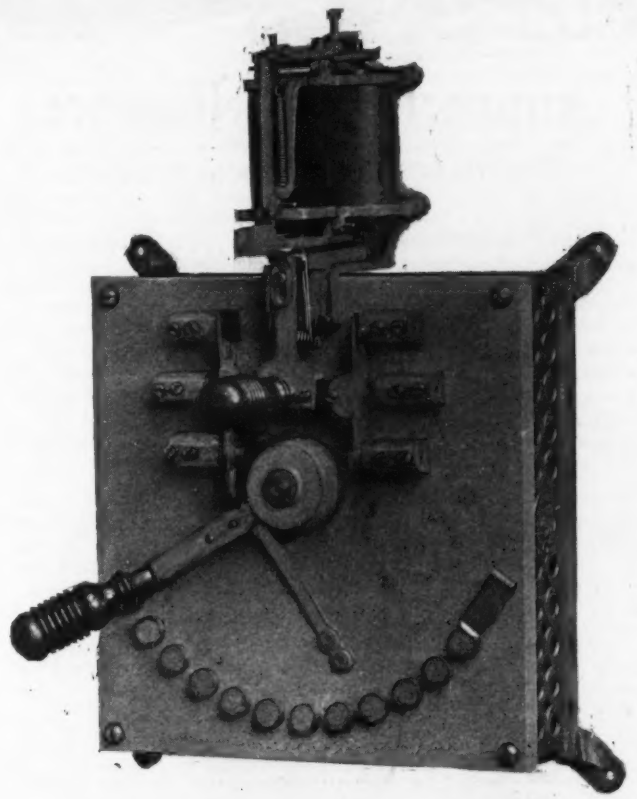


FIG. 1.—AUTOMATIC SWITCH AND RHEOSTAT.

work of releasing the catches is accomplished in the simplest possible manner, and so that failure to act is quite improbable. The adjustment of one armature does not in any way affect the other.

Fig. 2 represents the Card automatic safety and limit switch designed for use with motors not provided with a combination safety rheostat, thereby saving the user the cost of a new rheostat. This device operates in the same manner as the switch illustrated in Fig. 1, except that the rheostat arm is not returned to the starting position by the action of the magnet of the switch.

The features of the devices may be summarized as follows:

They will prevent excessive overload on the motor at starting, caused

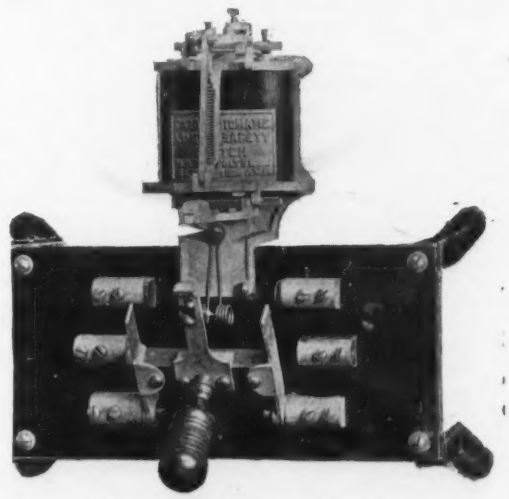


FIG. 2.—AUTOMATIC SWITCH.

by cutting out the resistance too fast; they will open the motor circuit and cut in the resistance instantly, if the current fails for any reason, and they will open the circuit and cut in the resistance if a load is put on the motor in excess of the limit for which the regulating spring is set. These devices are substantially built and very ornamental in appearance.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Sept. 14, 1895.

ERIE TELEPHONE reports net earnings for July as being $45,653.81, an increase of $14,348.13 as compared with the same month last year. When one considers the general showing made by the company this year, it is not surprising that the stock should begin to receive considerable attention in Boston. Treasurer Glidden is reported as stating that the stock has never sold quite up to its value, even at the recent comparatively high figures paid.

EDISON ILLUMINATING, of New York, reports net earnings for August as $53,015, representing a gain of $9,324 over the same month in 1894.

GENERAL ELECTRIC opened weaker as compared with last week's prices, and continued to decline up to the close to-day, last week's advance having had apparently no substantial foundation.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	120	125
Edison Electric Ill., New York	100	99	99½
" " " Brooklyn	100	110	115
" " " Boston	100	150	..
" " " Philadelphia	100	..	115
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	46	..
General Electric	100	37¾	38
General Electric, pref	100	69	71
Westinghouse Consolidated, com	50	36	36¼
" " pref	50	54	55

BONDS.

Edison Electric Ill., New York	105	105½	105½
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	..	90¾

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	198	199
American District Telegraph	100	35	40
American Telegraph & Cable	100	96	100
Central & South American Telegraph	100	117	120
Commercial Cables	100	150	..
†Erie Telephone	100	61	62
Gold & Stock Telegraph	100	105	..
New England Telephone	100	88	90
New York & New Jersey Telephone	100	103	105
Postal Telegraph-Cable	100	63½	..
Western Union Telegraph	100	92¾	92⅞

ELECTRIC TRACTION STOCKS.

Baltimore Traction	25	20	..
Binghamton RR. com	100	100	..
Brooklyn Traction	100	15	18½
" " pref	100	..	53
Buffalo St. Ry	100	88	91
Cleveland City Ry	100	69	70
Cleveland Electric Ry	100	59	60
Columbus St. Ry	100	48½	..
Consolidated Traction of N. J	..	25	..
Electric Traction, Philadelphia	50	74	75
Hestonville	100	58	..
Long Island Traction, all pd	100	19½	20½
Louisville St. Ry. com	100	37	39
" " " pref	100	87	88
New Orleans Traction	100	24	27
" " pref	100	79	81
North Shore Traction	100	34½	36
" " pref	100	84	88
People's Traction $30 pd	25	66¾	67
Philadelphia Traction	50	84¾	85
Rochester St. Ry	..	38	..
Union Ry. (Huckleberry)	100	112	115
West End, Boston	100	78	78¾
" " pref	100	92	92½
Worcester Traction	100	18	20
" " pref	100	86	90

BONDS.

Buffalo St. Ry. 1st con. 5s	100	106	109
*Binghamton Railway Co. 5s	100	99	100
*Columbus St. Ry. 1st 5s	100	104	..
Rochester St. Ry. 1st 5s	100	95	97
*Union Ry. 1st mtge 6s	100	105	108
*Westchester Electric 1st mtge 5s	100	98	101

* With accrued interest.
† Ex-Div.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, Sept. 16, 1895.

NON-UNION MEN REMOVED.—Builder Charles Wills has removed the non-union electrical wiremen on the American Surety Building pending the decision of the arbitration committee of the Board of Walking Delegates.

ELECTRIC EQUIPMENT FOR THE BRIDGE.—At a meeting of the Bridge Trustees on last Monday a resolution that the question of employing electric power to propel and switch the trains in place of the steam locomotives now in use be inquired into by the engineer was adopted.

THE MUNICIPAL COMPANY EXPANDING.—The stockholders of the Municipal Electric Light Company, Brooklyn, at a recent meeting, decided to increase the capital stock from $500,000 to $1,000,000. Forty-four thousand five hundred and sixty-four shares were represented, most of the stockholders appearing by proxy.

EDGEWATER, S. I., N. Y.—At the meeting of the Edgewater trustees on Tuesday, the Midland Electric Railway Company made an application for a franchise upon the Richmond Road and Van Duzen Street. President Johnstone doubted whether it could be granted, as the Interior Company had already been given a right of way over those streets. The matter was referred to counsel.

THE BROOKLYN HEIGHTS RAILWAY COMPANY has completed its improvements at its station at the bridge entrance, and a car of each of its lines will be constantly at the stand hereafter for the convenience of passengers. A staircase has been erected to make access to the bridge easier, and shelter also has been placed over the approach. The terminal will be brilliantly illuminated with electric lights at night.

BROOKLYN POSTAL CARS.—Postmaster Sullivan, of Brooklyn, is negotiating with the Brooklyn Heights Railway Company for the introduction of postal trolley cars on the Fulton Street line, and they will be introduced just as soon as he receives the approval of the Washington authorities. He also proposes before long to introduce postal cars on the cross-town line, and thus facilitate the transfer of the mails to and from Long Island City.

NEW LINE TO MANHATTAN BEACH.—The Nassau Electric Railway has just received a shipment of 14 car loads of steel rails for its branch line to Manhattan Beach. Five hundred men will be put to work at once laying the track, starting at Ocean Avenue. More men will be put on in proportion with the quantity of rails received. It is expected that the new branch will be ready by Oct. 1, and then patrons of the road may go to Manhattan Beach for five cents.

INCREASE IN CAPITAL STOCK.—The Electric Illuminating & Power Company of Long Island City, has certified to the secretary of state that it has increased its capital stock from $50,000 to $150,000. The amount of the capital actually paid in is $7,500 and the amount issued for labor done or property received is $42,500. The debts and liabilities are $87,441. Mr. Robert C. Pruyn, of Albany, and Ex-Mayor Edward A. Maher and Thos. W. Olcott, former well-known Albanians, are interested in this company.

THE PLAZA FOUNTAIN.—The lighting of the large fountain at the plaza at Prospect Park, Brooklyn, by means of electricity makes an attractive feature of this ornament of the city. Years ago there were rows of lamps about the fountain, and it was brilliantly illuminated. They were afterward removed and never restored. Under the last administration the Memorial Arch was lighted with electric lamps, but this has not been maintained by the present park commissioner. He has, however, made arrangements with the trolley companies to supply current for lighting the fountain, which will restore its previous nocturnal attractiveness.

MAYOR CHAS. A. SCHIEREN, of Brooklyn, whose belting has made his name familiar throughout electrical circles, has gone south for a fortnight's vacation, having remained at his post all Summer, attending not only to the immediate duties of his office, but also to the weekly meetings of the East River Bridge Commission. He will visit the Gettysburg and Chattanooga battlefields before attending the convention of electric light interests at Atlanta just before the exhibition opens. An effort to secure the renomination of Mayor Schieren is a feature of the political news of the week, but he firmly adheres to his determination to retire at the close of his present term.

DECISION IN ROYALTY SUIT.—Judge Bischoff, in the Court of Common Pleas, handed down a decision last week in the suit of George Maitland and the General Fixture Company against H. P. Drew and John May, in which he finds that "It is well settled that a licensee of a patent under a royalty contract cannot proceed to manufacture and sell the patented articles and resist a claim for royalties upon the ground that the patents were invalid unless they gave notice of their intention to repudiate the contract before the royalties accrued." The plaintiffs allege that the defendants, with the Edison General Electric Company, entered into an agreement by which the latter authorized them to manufacture and sell electric light fixtures and appliances, the plaintiffs to

receive 3 per cent. royalties on all net sales. The defendants filed an answer setting up that the patents under which royalties had been demanded had been declared invalid by the United States Circuit Court and that the plaintiffs, therefore, had no cause of action. The plaintiffs demurred to the answer and Judge Bischoff sustained the demurrer with costs.

NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, MASS., Sept. 13, 1895.

TEN-CENT FARES.—It is reported that the Lowell, Lawrence & Haverhill Street Railway will charge 10-cent fares, and make 40-minute trips between Lowell and Lawrence next year.

WAGES INCREASED.—The electric railway managers of Meriden, Conn., have just granted a voluntary increase of pay to the motormen and conductors in their employ. The old rate was 17 cents an hour; the new rate is 18½ cents.

THE CITY CONTRACT for lighting Providence, R. I., has been awarded the Fort Wayne Company, and it is stated that the loss of this contract by the General Electric Company will result in the removal of its plant from the city.

REDUCTION IN FARE.—The Danvers selectmen have been informed that the Lynn & Boston Street Railway Company will reduce the fares between Salem and Danvers (either station) to five cents. The company declined to make the fares five cents on the Putmanville, Asylum and Centre branches. The five cent fares from Danvers Village allow passengers to ride to Marblehead or Beverly line, a distance of more than six miles.

THE CONSOLIDATION of the Electric Storage Battery Company, of Philadelphia, and the Bradbury-Stone Company, of Lowell, is expected to result in a material reduction in operating expenses, and tend to still further improve the condition of the Electric Storage Battery Company's flourishing business. Mr. Arthur E. Childs, manager of the company's Boston office, will be ably assisted hereafter by Messrs. Jos. Y. Bradbury and Frank J. Stone, formerly of the absorbed company, besides Mr. Alfred Clarke, who was added to the staff upon the absorption of the Electric Light & Storage Battery Company some time since. With such an able team the New England business of the Electric Storage Battery Company should soon assume most gratifying proportions.

THE PERKINS LAMP COMPANY.—The Connecticut stockholders in the Perkins Electric Lamp Company are endeavoring to buy the stock in the company which is owned by Boston men, and if they are successful the company will resume operations in the manufacture of incandescent lamps at the old factory in the second story of the Mather Electric Company at Manchester. Although the Perkins company has been in existence, it has been two years or more since it did any business in the manufacture of lamps, having been forced to retire from active business by an injunction in the United States Court in favor of the Edison Company for infringement prior to the expiration of the Edison patent. The Perkins Electric Lamp Company was incorporated in March, 1889, with a capital of $50,000, and its stock was owned in Manchester, Hartford and Boston. While the company was in active operation, it employed from 100 to 175 girls and had a pay roll of from $1,000 to $1,500 a week. It cannot be definitely said at this time whether the Connecticut stockholders will succeed in getting the Boston stock, but it is welcome news to learn that an effort is being made to resume operations.

IMPORTANT RAILWAY TESTS.—Some very important tests of the application of electricity to the hauling of freight were made on the Nantasket Beach electric road on Tuesday. The experiments were witnessed by President Charles P. Clark, Third Vice-President James R. Kendrick, General Superintendent E. G. Allen, Superintendent J. C. Sanborn, of the Plymouth Division; General Superintendent C. M. Platt, of the New Haven system; Col. N. H. Heft, Assistant Electrical Engineer C. L. Stearns, Superintendent of Motive Power Henry Heaney, and Chief Engineer Curtis, of the Consolidated, all Prof. Elihu Thomson, W. H. Knight, W. B. Potter, C. C. Pierce and Gardner Wells, of the General Electric Company. The tests were made with the motor cars and heavily laden flat cars freighted with blocks of Quincy granite. Twelve carloads, weighing 400 tons, were easily handled, but with 14 carloads, weighing 470 tons, the train moved slowly. The power shown by the motor car in this last test was equal to that of a 42-ton steam locomotive. Two motor cars were then coupled together and attached successivly to 18, 21, 25 and 30 cars, carrying respectively 608, 714, 833 and 954 tons, all of which loads were easily handled. During this test something gave out on the four-motor car, and the entire load was moved by the two-motor car. The two-motor car was then attached to six cars, carrying 215 tons, and carried them to Nantasket Yard.

WESTERN NOTES.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., Sept. 13, 1895.

MR. Z. M. HUBBELL, secretary and treasurer of the Walker Manufacturing Company, Cleveland, O., is visiting Chicago this week, and expresses himself optimistically concerning the volume of business handled by his company so far this year, and expected this Fall.

FALL PROSPECTS.—S. G. Hicks, of the Independent Electric Company, says that the outlook for business this Fall with his company is most encouraging. The company is figuring on some very large contracts, which Mr. Hicks expects to close some time during the month.

THE INDIANA RUBBER & INSULATED WIRE COMPANY, of Marion, Ind., manufacturers of paranite, are the only makers of rubber-covered wires west of the Allegheny Mountains. Besides their line of regular insulations for inside wiring they also manufacture cables of every description.

W. W. LOW, president of the Electrical Appliance Company, returned home from his holidays on Saturday. He is in his usual genial spirits, and considers the outlook for business this Fall most encouraging. Thos. I. Stacey, secretary and treasurer of the company, has just left for the far west on a business and pleasure trip.

CANADIAN NOTES.

OTTAWA, Sept. 12, 1895.

CHARLOTTETOWN has contracted with the Royal Electric Company, of Montreal, for 65 arc lamps of 1,200 cp, each, at $73 per lamp per annum.

HAMILTON, ONT.—The Hamilton, Grimsby & Brice Electric Railway Company is having difficulty in getting sufficient power to run its trains between Grimsby and this city.

QUEBEC, QUE.—It is now stated that work on the electric street railway will not be begun in earnest until next Spring, as it has been found necessary to do a great deal more preliminary engineering work than at first estimated.

WELLAND, ONT.—Mr. Fraser, engineer and manager of the Toronto suburban electric railways, has been in Welland, with a view to getting information regarding the proposed electric railway between Welland and Fonthill.

HAMILTON, ONT.—The Hamilton Radial Electric Railway Company has applied for right of way along Cannon Street. It is understood that the company has abandoned for the present, at least, all idea of extending the Niagara Central, the present intention being to construct a double-track trolley road between Hamilton and Niagara Falls. Ninety-pound rails are to be used in the track construction.

MONTREAL.—Mr. Chas. R. Hosmer, manager of the Canadian Pacific Telegraph Company, has just returned from the Pacific coast with John W. Mackay. The telegraph business, Mr. Hosmer says, is picking up wonderfully in Manitoba, the Northwest, and in British Columbia. Speaking of the proposed cable to connect British Columbia with Japan, he said that Mr. Mackay tried to impress upon the leading men of Vancouver and Victoria the necessity of laying this cable to Japan. Mr. Mackay, he said, was giving a great deal of thought to the matter.

ENGLISH NOTES.

[FROM OUR OWN CORRESPONDENT.]

LONDON, Sept. 4, 1895.

THE PRIMARY BATTERY GENIUS.—The wonderful faculty of the genius who invents primary batteries for finding out principles and materials in Nature of which no one else has ever dreamed, is developing itself in more than one direction at the present time. The result is that a perfect boom in primary batteries threatens to overwhelm the ignorant investor. The latest material discovered is a mysterious substance known as "electric sand," but whether it is either *electric* or *sand* the prospectus does not enable one to judge, nor is there any information granted as to how this material is to be used. Another wonderful material is a "substitute" for zinc, the properties of which are also *in nubibus*. This wonderful substitute will, in a certain battery known as the "Milver" portable battery, either light a cathedral or simply light a man to bed, according to the account given by the chairman of the directors. It may also be used for driving produce wagons at "the highest rate of speed." But for all these wonderful inventions we on this side of the Atlantic are still making dynamos and building steam engines.

SNAEFELL MOUNTAIN ELECTRIC RAILWAY.—The electric railway which has recently been opened to the summit of Snaefell, the highest peak in the Isle of Man, is worked on the overhead conductor system, which differs from the ordinary trolley system in having a slider conductor bar instead of a trolley wheel. The line is about 4.7 miles long, and extends from Laxey along a spiral route, and up a 1 in 12 gradient, to within 44 feet of the summit of the mountain, the altitude attained being 2,000 feet above the sea level. The only justification for the construction of this line is the magnificent view from the summit, there being no residence on the top of the mountain. The line is double throughout, and is provided on both tracks with a "Fell" middle rail, which serves the double purpose of acting as a centre guide rail and of providing for a central grip brake, which is used slightly in the descent, and which will pull the car up in its own length in an emergency. The cars are provided with four 25-hp series wound Mather & Platt motors, spur-geared by single reduction to the bogey wheels. They are each 35 feet long and will carry about 50 passengers. There are no trailers. The present rolling stock consists of six of these motor cars, but others are contemplated, besides which some freight motor trucks are about to be built.

The tractive force required to move the car when full is 2,850 pounds, and with a normal current the motors exert a pull of about 3,500 pounds. The generating station is about half way up the mountain, this site being necessary owing to difficulties in obtaining water, and because the centre is a good feeding point. There are no other feeding points, except that at the lower extremity of the line, where there is a large battery station, comprising 246 chloride cells, connected in series to the overhead conductor. The generating station is equipped with five 120-hp Mather & Platt sets, each consisting of a horizontal compound non-condensing engine, belt-connected to a bipolar shunt dynamo, with a Gramme-ring armature. The entire system is connected by telephone, the conductors of which are carried on the tops of the overhead conductor poles. These poles are planted at 150 feet pitch between the two tracks. Each pole carries a cross-arm, from which the conductors of No. 0 hard-drawn copper wire are suspended. The system is worked at 500 volts. Great credit is due to the resident engineer, Mr. R. H. Willis, for the enterprising way in which the electrical equipment of this line has been pushed forward in the face of the most trying and sometimes tempestuous weather. The whole of this equipment was erected in seven weeks, and all the overhead conductors and poles were erected in eight days. The first sod was cut eight months before the opening ceremony.

General News.

NEW INCORPORATIONS.

THE PEOPLE'S ELECTRIC COMPANY, Madison, Wis., has been formed for the purpose of dealing in electrical supplies, by L. W. Kroucke, F. H. Ford, L. E. Kerns, Madison, Wis. Capital stock $10,000.

CONSOLIDATED ELECTRIC MANUFACTURING COMPANY, Milwaukee, Wis., capital stock $15,000, has been incorporated for the purpose of manufacturing electrical supplies. The promoters are H. S. Esch, John Koerts, F. W. Koeppm, Milwaukee, Wis.

THE PORT TOWNSEND GAS WORKS, Port Townsend, Wash., has been incorporated to construct, own and operate gas and water works, and a system of electric lights. The promoters are John Lillie, E. W. Anderson, R. G. Hooker. Capital stock $25,000.

THE ELMIRA SAFETY APPLIANCE COMPANY, Elmira, N. Y., has been incorporated for the purpose of manufacturing and dealing in electric engine stops, auxiliary governors, etc., by C. J. Langdon, C. M. Diven, J. C. Miller, W. M. Wood, Elmira, N. Y. Capital stock $5,000.

THE RANDALL-NOBLE ELECTRIC COMPANY, Bridgeport, Conn, capital stock $2,000, has been formed for the purpose of manufacturing and selling electrical appliances, etc., by Purdy M Randall, Bridgeport, Conn.; R. C. Noble, S. Windsor, F. S. Noble, Staten Island, N. Y.

THE CHICAGO CITY STREET RAILWAY COMPANY, Chicago, Ill., capital stock $1,000,000, has been incorporated for the purpose of building, maintaining and operating street railway lines in and about Chicago. The promoters are A. C. Scott, A. J. Hawhe and T. C. Kane.

THE MANHATTAN GENERAL CONSTRUCTION COMPANY, New York, N. Y., capital stock $50,000, has been incorporated for the purpose of manufacturing machinery and electrical apparatus. The promoters are C. B. Hill, B. A. Gould, Jr., Cortland Betts, E. H. Floyd-Jones, New York City.

THE ELECTRIC GOLD EXTRACTION COMPANY, Council Bluffs, Iowa, has been incorporated with a capital stock of $1,000,000 for the purpose of mining and reduction of gold and other metals by electricity. The promoters are Robert McKnight, C. M. Taylor, J. R. McKinnie, E. C. Broadwell and W. C. Smith.

THE LOUIS McCARTHY INSULATING COMPANY, Saco, Maine, capital stock $200,000, has been organized for the purpose of manufacturing and dealing in insulators for electrical purposes. The incorporators are Thomas Allen, Richard A. Atwood, Louis McCarthy, Boston, Mass., and A. E. Thompson, Reading, Mass.

THE L. A. LEASE COMPANY, Portland, Me., has been incorporated for the purpose of manufacturing and dealing in all kinds of electrical and mechanical apparatus and appliances. Those interested in the project are Josiah H. Drummond, Jr., W. G. Chapman, William H. Hatch, Portland, Me. Capital stock $50,000.

THE COLORADO GOLD ELECTRIC EXTRACTION COMPANY, Colorado Springs, Col., has been formed for the purpose of carrying on a general mining and milling business by electrical process. The incorporators are Robert McKnight, C. M. Taylor, J. P. McKinnie, Colorado Springs, Col. Capital stock $1,000,000.

THE PNEUMATIC MANUFACTURING COMPANY, Philadelphia, Pa. capital stock $30,000, has been formed to manufacture pneumatic electrical and mechanical appliances and apparatus. The promoters are Thomas R. Brown, New York City; James J. Martin, Philadelphia, Pa.; Thomas B. Shriver, Philadelphia, Pa.

THE BULLION TOWN SITE COMPANY, Bullion, Colo., has been formed for the purpose of owning town sites, selling lots, building water, gas and electric works, etc. Those interested in the project are E. C. Linstrom, O. J. Linstrom, Ed. Rhay, V. Carothers, James R. Davis, J. M. Church, R. L. Liggitt, Bullion, Colo. Capital stock $50,000.

THE GALLIPOLIS & POINT PLEASANT RAILWAY COMPANY, Gallipolis, Ohio, has been formed for the purpose of constructing and operating an electric railway between Gallipolis and the K. & M. Railway Bridge over Ohio River. Among the promoters are John L. Vance, Hollis C. Johnston, L. E. Jones, Lawrence H. Cott and C. R. Duffey. Capital stock $50,000.

THE ÆTNA ELECTRIC COMPANY, Hartford, Conn., capital stock $25,000 minimum, maximum $50,000, has been incorporated in West Virginia, for the purpose of manufacturing, buying and selling incandescent electric lamps and parts thereof, electric light specialties, etc. The incorporators are George S. Miller, Henry Green, Charles F. Reinmann, Arthur Howard, Hartford, Conn.

THE HATCH STORAGE BATTERY COMPANY, Philadelphia, Pa., has been incorporated in West Virginia for the purpose of manufacturing, buying and selling storage batteries, electrical supplies under patent rights, etc. Those interested in the project are George D. Armstrong, John W. Bethel, Lewis C. Maus, Theo. Hansen, Philadelphia, Pa. Capital stock, minimum $300, maximum, $5,000,000.

THE PHOENIX NATIONAL TELEPHONE & CONSTRUCTION COMPANY, Des Moines, Iowa, capital stock $1,000,000, has been formed to construct, own, operate and manage telephone exchanges and plants, electric railways and real estate. Among those interested are Charles M. Waterbury, John W. Paris, Noah J. Clodfelter, Charles D. Meeker, Gould Rhodes, Jacob Frankel, George Hadley and J. M. Smith.

MACOMBER-GRAYSON COMPANY, San Francisco, Cal., capital stock $100,000, has been organized to buy, sell and operate mines, mining properties, mills, mining machinery, construct and deal in dams, ditches, flumes, electric light and power lines, manufacture and generate power, light and heat, produced by electricity, water, compressed air or steam. Those interested are Charles A. Macomber, George W. Grayson, jr., Eugene H. Gould, Edwin P. Cole, J. O. J. Greeley, San Francisco, Cal.

TELEGRAPH AND TELEPHONE.

STANFORD, KY.—A telephone exchange is to be established.

PADUCAH, KY.—It is proposed to establish a telephone exchange at this place.

JACKSON, GA.—Stephen B. Kinard will soon erect a telephone line from Jackson to McDonough.

BEDFORD, IA.—Agents of the Conway Telephone Company are in Bedford attempting to organize an exchange.

DELAWARE, O.—The City Council has granted a six months extension of the telephone franchise to D. S. Fisher and associates.

FRANKLIN, IND.—The City Council has reconsidered its action by which a 20-year franchise was granted to the Phœnix Telephone Company.

EAU CLAIRE, WIS.—Extensive improvements are to be made in the Wisconsin Telephone Company's system. E. B. Cottril is general superintendent.

ANDERSON, IND.—The Pana Telephone Company proposes to build exchanges at Anderson, Tipton, Kokomo, Logansport, Summitville and Alexandria, connecting them with Elwood.

SHEBOYGAN, WIS.—The Common Council has granted a franchise to the Northwestern Telephone Construction Company of Milwaukee, of which H. E. Ferdinand is the representative.

SEYMOUR, IA.—It is proposed to construct a telephone line from Seymour to Corydon, via Promise City. R. E. Lowry, John Hoschar, W. C. Morgan and others, of Seymour, and C. A. Sager, Promise City, are interested.

SUMMIT HILL, PA.—A new telephone company has been organized at Summit Hill in opposition to the Pennsylvania Company. Dr. T. W. Renshaw and William and Joseph Snyder, of Summit Hill, with others, are the promotors.

ELECTRIC LIGHT AND POWER.

AUGUSTA, WIS.—The town has voted to put in a $12,000 electric light plant.

VICKSBURG, MICH.—Vicksburg is agitating the question of water works and electric lights.

BELLEFONTAINE, O.—The City Council has decided to purchase a steam engine for its electric light plant.

SOUTH PEORIA, ILL.—The Village Board has decided to have electric lights, and will expend $150,000 on the project.

FERGUS FALLS, MINN.—At a special election recently held it was decided to issue $25,000 bonds to build electric light works.

LA PORTE CITY, IA.—The people of La Porte have voted in favor of allowing a franchise to the Electric Light & Water Company.

AUGUSTA, WIS.—A special election held to vote on the question of bonding the city for $1,200 to put in an electric light plant, resulted favorably.

ANN ARBOR, MICH.—The Ann Arbor City Council has awarded a five year contract for lighting the city to the Michigan Electric Company of Detroit.

RUSH CITY, MINN.—Dr. A. J. Stowe, W. Wadlow and C. F. Jackson have been granted an electric light franchise for 30 years by the Common Council of Rush City.

AURORA, ILL.—The Council has granted a franchise to the Aurora Edison Light Company, which proposes to purchase a site and erect a $40,000 plant. Dr. I. W. Pritchard is president of the company.

BORDENTOWN, N. J.—An ordinance authorizing the Bordentown Electric Light & Motor Company to construct and operate works for the supply of electricity has passed first reading in the Common Council.

MILWAUKEE, WIS.—Bids will be received Sept. 31 for furnishing material and labor necessary to erect a library and museum building. The specifications include electric work. Wm. J. Fiebrantz is comptroller.

LAUREL, MD.—The Board of Trustees of the Keeley Institute will receive bids for constructing an electric light plant of 200 lamps capacity, with necessary arresters, switchboard, wiring, etc., complete, to be operated by a 15-hp steam or gas engine.

BLUE EARTH CITY, MINN.—The authorities of Blue Earth City have called a special election to vote on the proposition to issue $10,000 in bonds for the purpose of buying and enlarging the electric lighting plant. The owner offers the plant for $7,360, and if the bonds are voted, an arc dynamo and a new boiler will be added.

THE ELECTRIC RAILWAY.

JACKSONVILLE, FLA.—Work on the electric road from Jacksonville to Tampa will be commenced some time next month.

NORWALK, O.—It is reported that the Sandusky, Milan & Norwalk electric railways will change ownership within the next few days.

MANCHESTER, CONN.—Work on the new power house of the Hartford & Manchester Street Railway Company has been commenced.

BURLINGTON, VT.—The Military Post Street Railway Extension Company has filed a petition for the location of an electric street railway.

CANTON, O.—The Canton & Wooster Railway Company will build a road between Canton and Massillon, which will be electrically equipped.

PITTSTON, PA.—Senator James L. Slocum is interested in a scheme to build an electric railway to connect with the Wilkes Barre & Scranton lines.

KEENE, N. H.—The Keene Electric Railway Company has authorized a committee to contract for the construction of an electric system in this place.

ST. AUGUSTINE, FLA.—The Jacksonville & Tampa Bay Improvement Railway Company will commence work on the electric light and street railway plant at once.

LOS ANGELES, CAL.—D. M. McGarry has made application to the Board of Public Works for a franchise for a street railway, to be known as the Los Angeles Belt Railway.

BENNINGTON, VT.—The Bennington & Woodford Electric Railway Company has applied to the trustees of the village for right to extend its tracks through Main Street.

RICHMOND, VA.—An ordinance has been passed authorizing the Richmond Traction Company to construct and operate a street railway within the limits of the city of Richmond.

POUGHKEEPSIE, N. Y.—It is reported that the Poughkeepsie Transportation Company is to build the New Paltz & Highland road, a charter for which was obtained some time ago by B. Van Stevenburgh, of 53 Broadway, New York City, and Goshen, N. Y.

URBANA, O.—The City Council has granted the right of way to the Springfield Street Railway Company to enter the city. It has also passed an ordinance granting right of way to enter the city, to a similar road, to be built between here and Mechanicsburg.

WASHINGTON, D. C.—It has been announced by Frank C. Drane, general manager of the Washington, Sandy Springs & Baltimore Railway Company, that a survey of his company's proposed line has been completed. This line, if built, will make the second electric link between Baltimore and Washington.

HARRISBURG, PA.—The North Susquehanna Transit Company, which was incorporated on Aug. 1, has been granted franchises in Danville, Bloomsburg, Catawissa, Rupert and Riverside, and the work on the construction of the road will soon be commenced. E. S. Whitney, of Allentown, is president of the road.

WHEELING, W. VA.—The Second Avenue Traction Company, of Pittsburg, is negotiating for the purchase of the Wheeling Railway, also the Belair & Martins Ferry Road across the river, and it is understood that the Traction Company will build lines connecting the Wheeling roads with Pittsburg lines at Carnegie, Pa.

HARRISBURG, PA.—The Harrisburg & Mechanicsburg Railway Company has been reorganized, with Hon. B. F. Myers as president. The company has succeeded in having the injunction which restrained it from crossing a highway bridge near West Fairview, Cumberland County, dissolved by Judge Biddle. This will give the line an entrance to West Fairview.

SYRACUSE, N. Y.—The Council has passed over the mayor's veto the resolution giving a franchise to the Syracuse & Oneida Lake Electric Railway Company. The company agrees to pay into the city treasury on Jan. 1 of each year one mill for each passenger carried during the preceding 12 months. If the money is not paid, the city may recover it by an action at law, or declare the franchise forfeited, at the option of the city authorities.

Trade and Industrial Notes.

GOOD NEWS.—The Onondaga Dynamo Company, of Syracuse, N. Y., reports a most prosperous season. The company has had to more than double its manufacturing capacity to keep up with orders received.

TO FLATTEN THE LOAD CURVE.—The Electric Storage Battery Company, of Philadelphia, has closed a contract for a battery to be used in the Edison Station at Lawrence, Mass. The battery will consist of 140 chloride cells and will be discharged at the rate of 100 amperes for about three hours to assist the generating plant during the period of heavy load.

THE NEW CAR BARN for the Hartford (Conn.) Street Railway Company will be designed and built by the Berlin Iron Bridge Company, of East Berlin, Conn. The office will be located in the front end of the building on State Street, with the barn proper in the rear. The whole construction is to be of steel and fireproof, the roof being covered with the Berlin Iron Bridge Company's patent anti-condensation corrugated iron roof covering.

IN AN ATTRACTIVE CIRCULAR issued by the Mason Electric Company, 307 Dearborn Street, Chicago, and describing the celebrated Medbery insulating material for which the company is the Chicago agent, attention is called to the fact that Mr. W. R. Mason, general manager, has had five years' practical experience in electric railway supplies exclusively, thoroughly understands the requirements of electric roads, and believes that he is in a position to handle their orders intelligently and satisfactorily.

THE WORCESTER ELECTRO-MARBLEIZING COMPANY, of Worcester, Mass., is making a specialty of finishing metal used for electrical work, such as covers for snap switches, push buttons, bell gongs, etc., and is also doing considerable work in finishing fixtures. The effect of electro-marbleizing is a beautiful imitation of marble, onyx or pearl on brass, iron, copper etc. It is claimed that by this process the effects can be produced in an endless variety of colors and shades. The finish is durable, will not tarnish and requires no labor to keep it polished.

THE KNOWLES STEAM PUMP WORKS, 95 Liberty Street, New York, have issued the following card: "Referring to the recent fire at our works in Warren, Mass., we have noticed in a number of the papers exaggerated reports of the occurrence. We take this means of informing our friends and patrons that the fire was confined to the iron foundry and to one of the pattern houses, and that the total loss will not exceed $140,000, fully covered by insurance. Our facilities are such that very little, if any, interruption will be caused to our business by the above-named fire."

AN ATTRACTIVE NEW CATALOGUE has just been published by J. E. Lonergan & Co., 211 Race Street, Philadelphia, manufacturers of high-grade engine and boiler trimmings. The catalogue includes oil cups, crank-pin oilers, sight feed lubricators, water gauges, combination water columns, gauge cocks, indicator cocks—in short, a complete line of engine and boiler brass trimmings. Besides the goods of its own manufacture the firm handles some fine specialties of other makers. The catalogue is of a very handy size and shape, and is nicely bound in cloth, forming an unusually good reference book.

CHAS. A. SCHIEREN & CO., the leather belt manufacturers of New York, Boston, Philadelphia, and Chicago, have just shipped a large exhibit of their products to the Cotton States & International Exposition, which opens this month at Atlanta, Ga. The exhibit will consist of large main driving belts of the "Electric" and "Perforated Electric" brands, also dynamo belts, and belts for saw mill and cotton mill work. The largest belt running at the Exposition will be a main drive 36 inches wide, which will be a Schieren "Perforated Electric." Schieren & Co. will also have about a dozen of their "Perforated Electric" belts in service driving dynamos.

REFLECTORS IN CHURCHES.—I. P. Frink, of 551 Pearl Street, New York, has recently installed his well-known system of reflectors in the following churches and prominent buildings: First Baptist Church, Mt. Carroll, Ill.; Congregational Church, Clear Lake, Ia.; Baptist Church, Hopkinsville, Ky.; Y. M. C. A. Auditorium, Brooklyn, N. Y.; Church of the Magdalene, Pocantico Hills, N. Y.; Lodge No. 52, B. P. O. Elks, Chillicothe, O.; Congregational Church, Putnam, Conn.; First Presbyterian Church, Rushville, Ill.; Lutheran Church, Mt. Carmel, Pa.; First Presbyterian Church, Pine Bluff, Ark.; Presbyterian Church, Hampton, Va.; Presbyterian Church, Huntingdon, Pa.

ELMER G. WILLYOUNG & CO., Betz Building, Philadelphia, have issued an interesting supplement to their catalogue N, which is designated as List No. 105. The supplement contains descriptions and prices of a large number of instruments not heretofore listed. Among the specialties are an improved Nalder lamp and scale for use in connection with reflecting galvanometers, a congress standard cell, a variable standard of self-induction (Nalder Bros.), Pupin's electrodynamic interrupter, Rowland's form of Boys' radio-micrometer, and Smith & Sons' non-magnetic chronographs. In addition to these there are numerous pieces of apparatus designed especially for schools and students, Wimshurst machines, etc., etc.

HOEFGEN, MOXHAM & CO., contractors and general supply agents, 80 William Street, New York, who are New York agents for the well-known "Medbery" railway material, report orders for over $100,000 worth of these goods since they started in business a few weeks ago. In a nicely executed and handy catalogue just issued, the firm states that it is in position to furnish any and every article needed by street railways, and special reference is made to line material, poles, snow plows, and new "Bonta" emergency brakes, power-house equipment, cars, motors, headlights, registers, Okonite wires and cables and Manson tape. Specially large orders are reported as received from the following roads: Allentown & Lehigh Valley Traction Company, Allentown, Pa.; Nassau Electric Company, Brooklyn; Yonkers Railway Company, Yonkers, N. Y.; Fort Wayne Electric Railway Company, Fort Wayne, Ind., and Citizens' Railway Company, Detroit, Mich. Messrs. Hoefgen, Moxham & Co. claim to handle only the best goods and assure intending purchasers of prompt, courteous and honorable treatment.

THE SATISFACTORY CHARACTER of the Peck boilers now in use by the Public Lighting Commission, of Detroit, has called attention of engineers and large steam users to this improved style of shell boiler. The Detroit boilers are seven in number, each rated at 300 hp, and designed for carrying 165 pounds of steam, for serving triple-expansion vertical engines. Since these boilers commenced to be operated on the 1st of April, the designer, Cassius C. Peck, 39 State Street, Rochester, N Y., has been awarded several contracts of the best class, among which are three 300-hp, externally-fired boilers, for carrying 150 pounds working pressure, for the Ohio Institution for Feeble-Minded Youth, at Columbus, O.; one 250-hp, internally-fired boiler, for 150 pounds pressure, for the Bausch & Lomb Optical Company, of Rochester, and four 300-hp, externally-fired boilers, for carrying 165 pounds working pressure, to supply 30,000,000 gallons triple-expansion pumping engines for the city of Buffalo, it being intended that these engines shall be the most powerful pumping engines yet constructed in this country, and the plant as a whole the most economical in operation of any so far erected.

Business Notices.

ELECTRIC LEAGUE.—Meets every Thursday evening, 100 West 24th Street New York. Electrical engineers and electricians cordially invited.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 15 South Warren Street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

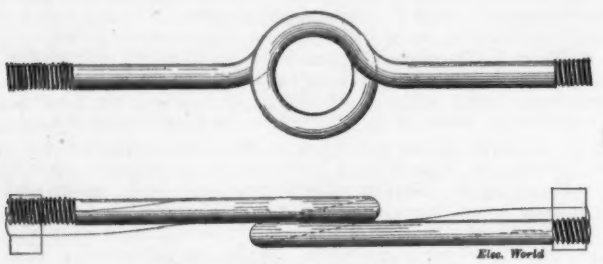
UNITED STATES PATENTS ISSUED SEPT. 10, 1895.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

545,869. RAIL BOND; R. A. Baldwin, South Norwalk, Conn. App. filed Jan. 24, 1895. A rail bond consisting of two plug supports adapted to be attached to the rails by screw threads, and a connecting conductor consisting of a stiff rod or wire threaded at both ends into the plugs.

545,903. ELECTRIC SIGNALING APPARATUS; App. filed Aug. 1, 1894; 545,904. App. filed Sept. 6, 1894; G. E. Miller, Stoneham, Mass. A signaling system having a conductor extending along the track, an apparatus in a main circuit operated by alternating currents, and means for automatically indicating the condition of the main circuit, comprising electrical apparatus in an open shunt circuit adapted to be closed when the main circuit is broken.

545,921. TELEPHONE EXCHANGE APPARATUS; A. Stromberg, A. Carlson and H. L. Knight, Chicago, Ill. App. filed Feb. 28, 1895. The combination of a telephone line terminating at a central station in a switching device, an individual annunciator having two windings, one a series and the other a shunt, with one side of the telephone circuit situated between the switching device and the shunt circuit.



No. 545,869.—RAIL BOND.

545,922. TELEPHONE APPARATUS; A. Stromberg and A. Carlson, Chicago, Ill. App. filed March 29, 1895. The combination of a microphone transmitter mounted upon a rotatable shaft, a shaft carrying a hook on one end and a handle for rotating the shaft provided at the other end, contact points forming the terminals of the local transmitter circuit, adapted to be controlled by the rotation of the shaft.

545,938. TELEGRAPH RECEIVER; O. P. Briggs and W. R. Patterson, Chicago, Ill. App. filed Oct. 11, 1893. The combination of a lever adapted to operate a wheel operating a punch, which causes a die when a signal is given to perforate paper tape.

546,002. ELECTRIC DRILL; C. S. Bradley, Avon, N. Y. App. filed Aug. 20, 1892. The combination of a differential phase alternating-current generator adapted to periodically reverse the order of phase delivery, a reciprocating motor connected with the differential circuits supplied by the generator, whereby a progression of the poles to and fro along the axis of the coils is maintained.

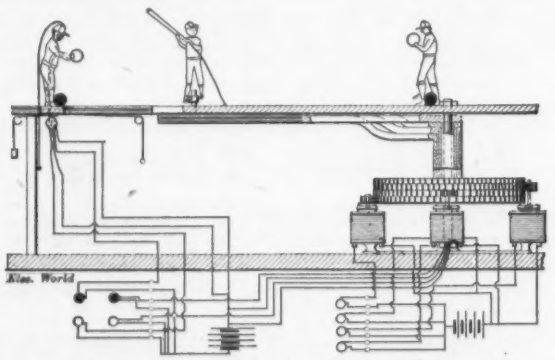
546,003. BASE-BALL INDICATING APPARATUS; F. M. Chapman, New York, N. Y. App. filed May 23, 1895. The combination of a board having a field diagram, different colored lamps mounted thereon to indicate the positions of the players, other lamps to indicate the course of the ball, and electric circuits suitably controlled leading to the lamps.

546,005. FLEXIBLE CONDUCTOR AND ENCLOSED CONDUIT THEREFOR; L. Dion, Natick, Mass. App. filed Feb. 20, 1895. The combination of a series of conducting plates forming the top of the conduit, an auxiliary and a main conductor enclosed within and insulated from the lower portion of the conduit and adapted to supply current to the auxiliary conductor, the latter being drawn by magnetic attraction against the lower faces of the surface plates.

546,027. TELEPHONE; E. C. Parker, London, Eng. App. filed Feb. 14, 1895. The combination of a vibrating diaphragm carrying a rotatable carbon holder mounted in bearings and filled or partially filled with carbon.

546,036. App. filed Aug. 22, 1893; 546,037. App. filed Jan. 25, 1894. SIGNAL BOX; N. H. Suren, New York, N. Y. A signal box having a switch comprising a local, short and a test circuit, arms for making contact, the said arms being moved on to the local circuit by the opening of the door, the test circuit by hand, and the short circuit by contacts upon the closing of the door.

546,059. ELECTRIC RAILWAY; W. M. Schlesinger, Philadelphia, Pa. App. filed Nov. 24, 1885. The combination of separate feeding conductors extending in multiple arc relation from one terminal to points along the line of way, safety devices for feeding separate conductors, a working conductor having a series of insulated sections disposed along the way and supplied by separate feeding conductors, and a return circuit connections opposed to the sections and leading to the other generator pole or terminal.



No. 546,003.—BASE-BALL INDICATING APPARATUS.

546,062. SPEED REGULATOR FOR ELECTRIC CARS; Isaac D. Aiken, New York, N. Y. App. filed May 4, 1895. A speed regulator for electric cars, having in combination with the propelling motors, main rheostat, and hand-operating devices, an independent box of resistance coils, supporting pivotally, a piece, provided with an insulated arm, forming a part of the motor circuit and adapted to be brought into contact with each of the said coils, the said pivoted piece possessing a second arm, slotted near its outer end to engage a pin, projecting from the sleeve, the said sleeve movable upon the axle of the car, and the centrifugal governor.

546,120. ELECTRIC BRAKE; W. Koedding, St. Louis, Mo. App. filed June 13, 1894. An improved electric brake having a coil or series of coils, fixed within a stationary metallic cylinder, and around an internal core, a coil around the internal core of a second cylinder and moving within the first cylinder, the core facing end of the stationary coil being preferably cone-shaped, and the corresponding core facing end of the movable coil funnel shaped.

546,130. CLOSED CONDUIT ELECTRIC RAILWAY; J. M. Deal, Fernwood, Pa. App. filed Nov. 26, 1894. A car having a motor thereon, a magnetic trolley arm depending therefrom and electrically connected therewith, and means for raising and lowering the said arm.

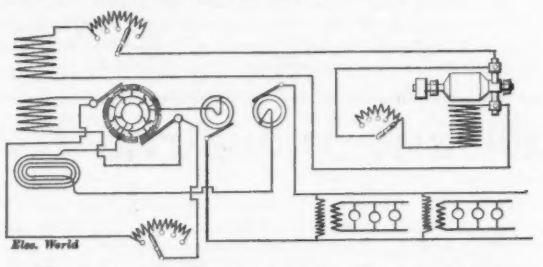
546,135. BELL BUOY; J. A. Fairbanks, Cambridge, Mass. App. filed April 15, 1895. A buoy having a bell arranged thereon, striking mechanism thereon also, wires leading from the buoy to a battery located at a distance, and an automatic circuit closer and breaker adapted to close and break the circuit to produce sounds corresponding with the chart number of the buoy.

546,143. ELECTRIC RAILWAY SYSTEM; H. A. Fry, Portland, Ore. App. filed June 13, 1894. The combination of a trolley shank, a housing having a guide for the trolley shank, spiral springs connecting the trolley to the housing, a laterally adjustable frame supporting the housing, and a support fixed to the car for carrying the laterally adjustable frame.

546,171. COMBINED PUZZLE AND TOY; F. J. Mantel, Syracuse, N. Y. App. filed Feb. 8, 1895. A toy consisting of a case, a diaphragm, a raised disc secured thereon, a movable magnet, armatures provided with convex surfaces and riding thereby upon the diaphragm, and miniature figures attached to them.

546,190. REGULATOR FOR ALTERNATING-CURRENT DYNAMOS; E. W. Rice, Jr., Lynn, Mass. App. filed March 16, 1888. The combination of a field sustaining coil of practically constant effect, and a field magnet coil and commutator therefor placed in the alternating-current main, a variable resistance in a branch of the main around said coil and connected to the circuit at points between the coil and commutator.

546,191. ELECTRIC LOCOMOTIVE; E. W. Rice, Jr., Lynn, Mass. App. filed March 18, 1895. The combination of a self-contained locomotive, a prime mover, a generator and rotary transformer both separately excited, with alternating-current motors mounted on the trucks of the said locomotive, and means for regulating the fields of both generator and transformer and thus varying the periodicity of the supply current.



No. 546,190.—REGULATOR FOR ALTERNATORS.

546,220. ART OF MANUFACTURING ELECTROMAGNETS; H. P. Brown, New York, N. Y. App. filed Jan. 26, 1893. A process consisting of coating one surface of the metal tape with shellac, imposing an asbestos tape thereon, and winding or turning the edges of the former with the latter, and then compressing the two together and partially drying the shellac, then winding the two with binding thread in open spirals, spooling it, winding the permanent tape in the permanent coil of the magnet, and applying shellac to the outside and pressing it until the shellac is partially dried, and then applying permanent holding devices.

546,228. SIGNAL TRANSMITTER; W. H. Davis and H. C. Christy, Como, Col. App. filed June 3, 1895. The combination of a cam, an angle lever actuated thereby, a toe on the cam, an angle lever connected to the first angle lever and actuated by the toe, a revolving drum, a contact arm connected to the angle levers and electrical connections.

546,232. INSULATOR, CONDUCTOR AND CONDUIT FOR ELECTRICAL WIRES AND CABLES; W. R. Hitchcock, Cornwall, Canada. App. filed Oct. 12, 1894. A sectional working conductor consisting of insulated blocks joining sections together, each of the sections comprising a wire and a strip of conducting material incasing said wire, the two edges of the strip being brought together and turned inwardly to form a stiff rib, whereby the said section is made rigid vertically.

546,233. AUTOMATIC ELECTRICAL CUT-OUT; C. C. Kritzer, Grand Rapids, Mich. App. filed Oct. 31, 1894. The combination of separate adjacent fixed contacts having a common connection, a revolving drum supported nearby, a switch bar being located therein, and a magnet-controlled lock for the switch bar to maintain the connection between the contacts.

546,247. ELECTRIC BRAKE; W. B. Potter, Schenectady, N. Y. App. filed Jan. 19, 1895. In an electric brake, a brake switch, fixed contacts co-operating therewith, an idle portion and operative contacts upon the brake switch, a controlling switch similarly provided with fixed contacts, operative contacts and an idle portion, and connecting mechanism between the two switches; whereby the fixed contacts of one switch are upon the idle portion of that switch while the fixed contacts of the other switch are upon the operative contacts of that switch and vice versa.

546,261. Filed Feb. 12, 1895; 546,262. Filed March 25, 1895. AUTOMATIC ELECTRIC FIRE ALARM; C. D. Tisdale, Boston, Mass. The combination of an electric motor, battery and magnet, a wire of fusible material connected at one end to the magnet and joining one pole of the battery, another wire connected to the other pole of the battery, a sounding device, a block and a wire running from the block to the sounding device.